Automotive Service Digest

Our 46th year June, 1958

What's the score on more service specialists?—See Page 11.

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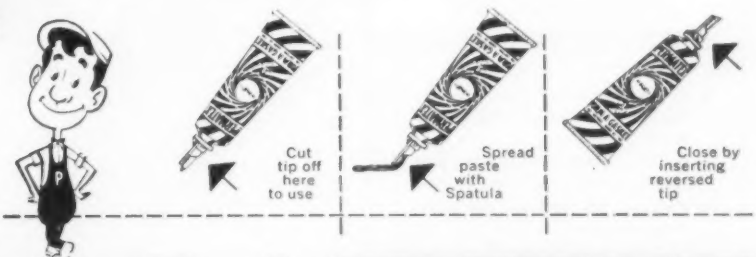

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OF THE MONTH !

FOR DEALERS

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VOLUME XXXXVI
No. 557

Digest

June 1958

Cover

Ferris Institute body work student preheats damaged section of automobile frame before it is stretched back to its original position.

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"TECH KNOW-HOW"
FEATURE ARTICLES

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For July

● Highways and biways will be bustling with vacation-bound motorists' cars, many of them air conditioned. We've already paved the way for servicing air conditioners in the current issue, and next month's article really gets into the innards of the units—how to check them and service them. Servicing air conditioners is not difficult, and once you've acquired the info your shop can appease the customer who is hot and bothered but who should be cool and comfortable.

● July finishes the series on automatic transmissions, thereby giving our readers full coverage of the various transmissions they will encounter in the shop. Save this article, along with the previous ones, and you've got the works!

● Another dandy article in the series "So you want to start a service shop." Some real meat in it—for those who have a yen for going into business and those already in it.

Automotive clinic

Stuck on some problem? Need help on a job? Write us about your problem on your shop letterhead and the information you are looking for will be promptly sent you.

Address your letter to Automotive Clinic c/o AUTOMOTIVE SERVICE DIGEST, 900 S. Wabash Ave., Chicago 5, Ill.

Ben Ikert, Editor

Crankcase Ventilator

We have been having idling trouble on a 1955 6-cylinder, 261 cu. in. Chevrolet truck engine with positive crankcase ventilation, and found it to be caused from the valve in the line to the manifold. Would it be harmful to plug up the manifold end of this line and leave it open where it connects to the base outlet?—*A.N.E., Green Lake, Wis.*

Answer: If you plug up the crankcase ventilating line you will have no crankcase ventilation. The valve you mention often sticks and gets plugged up, and frequent cleaning will keep it open. Unless you have excessive blow-by, the crankcase vent system should not affect the engine idle. We suggest that you check all the other factors that might affect the idle.

If you want to get rid of the crankcase vent system now installed, you may be able to adapt the vent tube used on the passenger car engine, and plug up the manifold connection.

Propeller Shaft Thump

What can be done to correct propeller shaft thump which occurs on a 1954 Cadillac? It takes place when the car hits a bump, on a turn and when brakes are applied.

The customer says it is more noticeable when several persons are in the car. We will appreciate any tips or suggestions you may have.—*P.N., Gulfport, Miss.*

Answer: Our suggestion is to hand seat with lapping compound the splines of the propeller shaft. Carefully remove any spline burrs with a smooth file. This should stop the splines from hanging up when the shaft is starting to move back from an extended position. Evidently this is what is happening. Note that the customer says under every condition where he finds the noise, the propeller shaft is in the extended position, due to movement of the car over an uneven plane or with weight inside the car.

Another possible source of this thump is transmission oil which sometimes seeps by the rear seal and becomes trapped in the space between the end of the output shaft and the yoke.

Reo Truck Valves Stick

The valves on a customer's two 1955, 220 h.p. Reo V-8's are sticking—just long enough when the engine is running for the push rod to fall off the rocker arm. This usually happens during the first few minutes of warm-up, but lately it has occurred while the truck is making a trip. This only happened on one of the trucks once in two years; but on the other truck it has occurred no less than ten times on the same valve—eight times during warm-up, and twice when the truck was traveling at 40 m.p.h.

The valves never burn, and they don't feel sticky. We simply put them back on the push rod and everything seems normal.—*H.J.H., Curlew, Wash.*

Answer: Valves sometimes stick because deposits are formed on the valve stem so that they hang up in the guides, the stem may be bent, clearance between guide and stem is too small, or the valve spring may be weak or broken. There is also a possibility that excessive tappet clearance could allow excessive valve opening shock, which could drive a valve up far enough in the guide so it will stick.

A treatment that will clean out valve stem deposits is to drain the oil, and fill the crankcase with a mixture of four quarts of kerosene and one quart of engine oil. Add to this one pint of Butyl Cello-Solve, and run the engine on this mixture for about one hour at idle (out of doors). Drain thoroughly and refill with engine oil in usual way. The Butyl-Cello-Solve can be purchased at any chemical supply house.

Why Valves Burn

We do quite a bit of engine overhauling. On some engines we notice that the valves are really burned. On others, they're just normally worn and dirty. Yet these are similar engines, and as far as we know are used about the same.

Can you give us any ideas as to why there should be this difference? —*V.B.U., Long Island, N.Y.*

Answer: The following are all of the possible causes of valve burning that we can think of. Hope this list helps you in your work.

Valves stick open.
Push rods stick holding valves open.
Valve seat not concentric with guide.
Valve stem bent holding valve open.
Inferior valve material.
Engine overheating.

Valve seats too narrow.
Lack of push rod clearance, valves hold open.
Lack of clearance between valve stem and guide.
Weak valve springs.
Too lean fuel mixture.
Water distributor tube corroded.

Truck Hums and Whines

I have a 1956 GMC ½-ton truck in my shop on which a hum or whine comes in at around 25 m.p.h. It's not a knock, and shorting out the plugs does not eliminate it. Could it be the metal cam gear?

Also, the motor does not run smooth at medium speed. Have ground the valves, put in new points, plugs, etc. —a complete tune-up. Gas mileage is about 12 or 14 m.p.g. Would another carburetor help?—*H.G., Novato, Calif.*

Answer: The noise you mention may be coming from the generator, or possibly it is actually a whistle, coming from a tiny air leak. Tighten the intake manifold and carburetor hold down nuts. Also check the exhaust manifold. We do not believe you would be getting noise from the timing gears unless they are operating without lubrication.

If the engine does not run smooth at intermediate speeds, this may be due to valve hanging open, air leaks in the induction system, spark plugs in

(Continued on page 68)

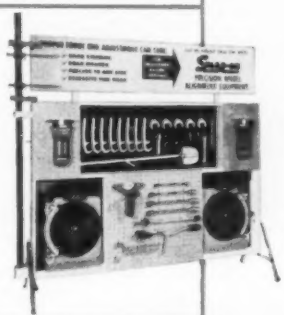
Item from Automotive News —

" . . . Boost Profits by Purchasing New Tools and Equipment on a Time Payment Basis . . . "

. . . "dealers noted for their profitable shop operation claim that both the better workman and customers gravitate to the shop that is best equipped."

Automotive News, Sept. 16, 1957

MT-615 Anal-O-Scope engine analyzer



2033-WA-S
Wheel alignment set

2029-AT-S Automatic transmission tools

This article in *Automotive News* says you can boost profits with new tools and equipment purchased on a time payment basis. *Snap-on* says, "We can serve you on both counts." First, *Snap-on* provides the most complete line of top-quality wrenches, mechanics' hand tools and shop equipment in the industry — automatic transmission tools, valve refacers, electrical testing equipment, electronic engine analyzer, wheel aligning equipment, to mention a few.

Second, *Snap-on* makes it easy for you to pay while you earn, through *Snap-on*'s popular, easy time payment plan.

In addition, *Snap-on* gives you another big plus — convenient, regular, personalized service from your *Snap-on* man. He knows tools, and he's right there to deliver, demonstrate and stand behind the tools and equipment he sells.

Now is the time to gear for big-profit repair business. It's there for the shop that can handle it. See your *Snap-on* man for the latest and finest in money-making tools and equipment.

MT-4000
Automotive
tune-up set

Ask about Whitworth and Metric tools for servicing foreign cars.

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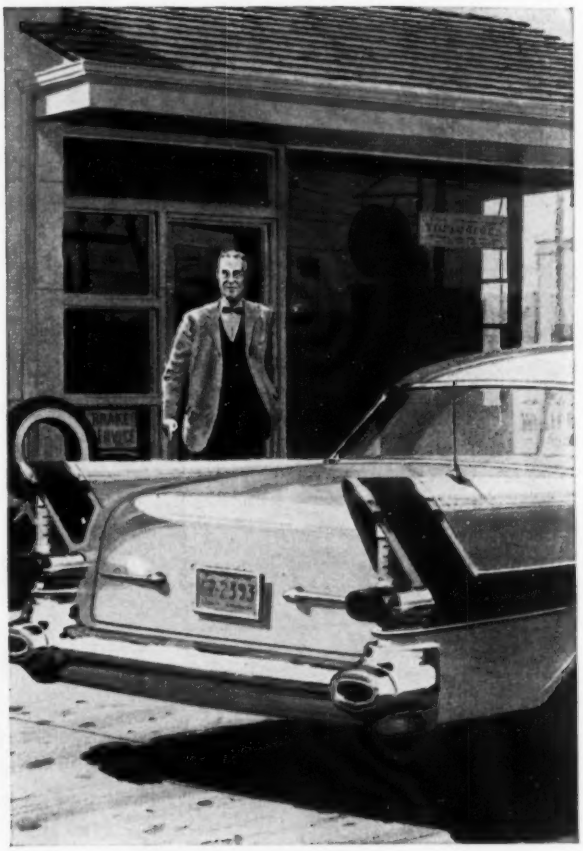
One of these two cars needs a new

Why not check their plugs and see which one? You'll be doing <u>both</u> customers a real favor... you'll make an extra profit... and it will only take a few minutes!



Recent studies show that half of all cars in use need new spark plugs.

This gives you a real opportunity to be of *genuine service* to your customers—while making an extra profit. Because it means that many of *your customers* aren't getting the proper performance from their engines—yet few of them realize they are being robbed of power and gas mileage by worn, misfiring plugs.

But when you install a new set of Champions, the driver will notice an improvement—immediately—and you'll have a more satisfied customer.

Every time you raise a hood, look at the spark plugs. If they're filthy on the outside, chances are good that they may need replacing. Ask if you can pull and check a plug. It doesn't take long. If the customer is in a hurry, suggest he come in later—and remind him that a new set of plugs can put new life and pep in his engine.

And you're always on safe ground when you recommend and install CHAMPION Spark Plugs. Champion engineers are *spark plug specialists*. They know how to design spark plugs that deliver full-firing power in *any make of car*—Champion Spark Plugs!

When the hood is up, look for dirty plugs. Chances are good that they should be replaced. When you suggest checking a customer's plugs, remind him that non-sparking plugs waste both power and gas.

World's favorite spark plug — engineered for every car

set of CHAMPION SPARK PLUGS

Every other car needs new spark plugs. It's your biggest opportunity to do a real service for your customers. And new Champions make your brand of gasoline perform better.

Check a plug in your Champion service unit. It doesn't take long. And the unit itself shows your customer if his old plugs should be replaced with new Champions—the spark plugs *engineered for every make of car.*

Dependable 5-rib

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SPARK PLUGS

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Thank you...MOTOR TREND!

. . . for reporting to your more-than-a-million readers the results of your actual field research test of the new Mileage Minder with magnetic Trouble Trap.

YOU'RE SO RIGHT! Later model cars particularly are giving trouble, due to skyrocketing fuel pressures and iron oxides in gasoline.

ANOTHER WAY TO SAY IT! ...Mileage Minder stops hammering fuel pump pulsations, smooths gasoline flow, while it purifies the gasoline.

PROOF! Motor Trend's test car increased gas mileage almost 4 miles per gallon. Smoother performance, more power and pickup.

Free reprints of this article are yours for the asking . . . for distribution to your customers.

PRODUCT USE TEST

MILEAGE MINDER

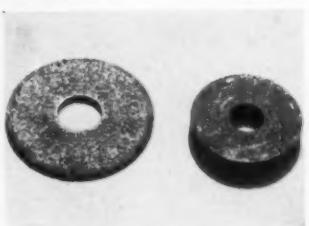
FUEL SYSTEM TROUBLES in the form of dying, stalling, flooding, and poor fuel economy are a frequent and annoying bugaboo. They are not, however, incurable. In fact we found the solution quite simple in a recent actual-use test of the Paser Manufacturing Co.'s Mileage Minder.

The heart of malfunctioning in most fuel systems is at the carburetor needle seat. As the needle responds to signals from the float it must seat exactly with dependable precision even though its action reaches a fluttering speed.

The two major causes of trouble at the needle seat are foreign matter in the fuel and fluctuating fuel pump pressures. Since the fuel pump forwards gasoline to the carburetor with a cam action, the pressure alternates between full thrust and zero thrust. This means that on the thrust cycle pump pressure may be multiplied to a point where the needle is prevented from seating with the result that flooding occurs with corollary engine stalling. Foreign matter can also prevent the needle from seating properly and the results are similar. As the needle is prone to become magnetized by the flow of fuel, metallic particles are particularly troublesome.

The Mileage Minder is designed to eliminate these common fuel system troubles. A spring-loaded two-ply neoprene diaphragm absorbs and cushions fuel pump pulsations. A sintered bronze filter screens general foreign matter and as the fuel must pass through the field of a ceramic magnet, metallic particles are trapped.

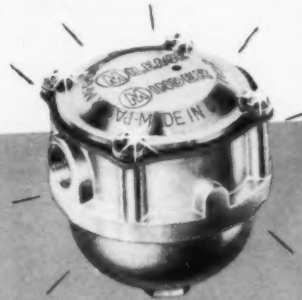
We were familiar with the Mileage Minder. (See "Fuel for Thought," Oct. '57 MT.) having previously installed one on a '55 Buick Special which exhibited the usual stalling tendencies and erratic idling after each hard application of the brakes. Later we installed the new model unit with the metal bowl and magnet.

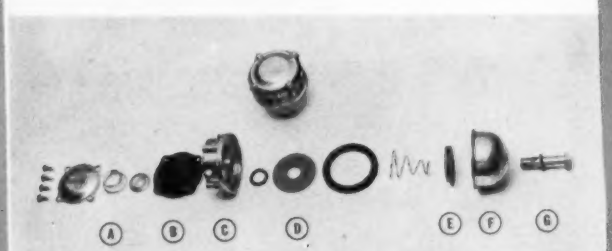


AFTER ONLY 500 miles of driving metallic particles were found adhering to surfaces of the ceramic magnet.

MILEAGE MINDER on '55 Buick Special

The stalling tendencies and rough idling cleared up shortly after the original installation was made and there was no repetition when the second unit was tested. Stalling as a result of flooding results in waste of fuel. When this was eliminated we found the fuel consumption was lessened from one to 3.8 miles per gallon, depending on where and how the car was driven. —MT Research Report





FUEL ENTERS Mileage Minder head (C), passes into bowl (F) through tube (G). After passing through field of magnet (E), it flows through sintered bronze filter (D). Fuel pulsations are dampened by diaphragm (B) and spring (A).

COMPARE THESE SALES MAKING FEATURES!

HUNDREDS OF THOUSANDS OF SATISFIED USERS / PATENTED ACTION SMOOTHS FLOW OF GASOLINE WITHOUT REDUCING MANUFACTURERS' RECOMMENDED FUEL PRESSURES. NO BALLS, VALVES, ADJUSTMENTS OR SETTINGS. DOES NOT CAUSE LEAN-MIXTURE STARVATION—NO DANGER OF BURNED VALVES / PURIFIES FUEL OF DUST, DIRT, GUNK, MINERAL OR METALLIC IMPURITIES/NEW, COMPACT METAL BOWL MODEL, EASY TO INSTALL / WIDELY ADVERTISED AND PUBLICIZED TO MILLIONS IN LEADING NATIONAL MAGAZINES / PRICED AT $7.95 WITH LIBERAL TRADE DISCOUNTS. OFFERED BY AMERICA'S LEADING DISTRIBUTORS. WRITE FOR FREE PRESSURE CHART AND ENGINEERING DATA.

PASER MANUFACTURING COMPANY, 533 TURK STREET, SAN FRANCISCO 2

Editor's page

Servicing must go to school

WITH THIS ISSUE, ASD launches a thoroughly planned and comprehensive editorial series on automotive service education based on the theme —"Learn More—Earn More."

The series is aimed to help the whole body of service personnel, from the old timer with a penchant for fixing things, to the high school lad aspiring to carve out a career as a qualified automotive service specialist.

By the same token it is hoped that the series will stimulate upgrading in the conduct of shops—dealer-operated and independent. Shop operators must come to recognize the value and importance of skilled service specialists and the type of work for which they are trained. Lack of this recognition breeds personnel discontent, and may well have a bearing on the present shortage of mechanics. The letter from a reader reproduced on Page 24 of this issue is a typical case in point.

There was a time when learning "on the job" sufficed for becoming a mechanic. Now, however, with motor vehicles having become vastly more intricate mechanisms, service demands that a mechanic, to act in the role of service specialist, be in effect—even if not formally—a "college trained mechanic."

Modern cars and those to come, demand capable and quick service; which requires thorough, technical training. It calls for skilled men with tech know-how and ability to use modern precision equipment and tools.

Service training, geographically speaking, is available practically the country over. The intent and purpose of ASD's Service Education series is to give as wide a coverage as possible of these service training sources. From it, the prospective student can select a strategically located school or program that fulfills his particular wants and ambitions, and meets his pocketbook.

Car factory service centers, public vocational trade schools, parts and equipment maker's schools, and association-sponsored training courses—all geared to service education—will be adequately represented in this ASD editorial service.

Back of it is a simple, single purpose: to stimulate the training of service personnel and promote the upgrading of the automotive service field itself, and thus to help attract the skilled men this field must have.

Ben Ikert
EDITOR

Servicing air conditioners

With the increasing number of cars being air-conditioned for passenger comfort, a profitable business of installing, testing and servicing the units awaits the shopman who understands how and what makes them work.

Part I—Principles of Refrigeration

• COMFORT AND CONVENIENCE sells cars. Power-operated tops, windows and seats, as well as power steering and brakes, together with automatic transmissions—luxuries a few years ago—are fast becoming "standard equipment". It is the American way to find the luxury of yesterday, often the necessity of today—and air conditioning of automobiles is no exception to this trend.

While *air conditioning* was largely limited to the luxury cars of a few years ago, its use *in all cars* is growing at an impressive rate.

Fortunately for the service shop, the many makes of air conditioners on the market today all operate on the same fundamental principle. As one mechanic put it, "The problem is to find where they hid the pieces".

So to get off on the right foot, let's look at the fundamentals of car air conditioning. Details of various makes, and the specific service procedures for each, are to be covered in future articles.

THREE PRINCIPLE UNITS

The accompanying schematic shows the "basics" of a car air conditioning system. Principal units are the belt-driven compressor (B), the condenser (A) mounted in front of the car radiator, and the evaporator (O) that cools the air in the car.

Car cooling is the result of applied refrigeration fundamentals no matter what the make of the equipment or shape of the units.

It is a law of physics that fluids absorb heat while being changed from a liquid to a gas, and they give up heat when changing from gas to liquid. You may have

By ED PACKER
Member, S.A.E.

Though a motorist may today literally ride on air, complete comfort is possible only when the motorist is in air of the right temperature and humidity.

noted this when a kettle on the stove boiled—the heat applied to the kettle boiled the water and produced steam. If this was observed on a cool day and the steam had a chance to strike the window glass, it was cooled and condensed into drops of water. You have also seen this condensation action when warm air in a room strikes the outside of a glass of ice water.

What we have been talking about was occurring at atmospheric temperature. But it is common knowledge that high pressure applied to a gas can bring the gas back to liquid form.

Manufacturing liquid air, and the reduction of petroleum gases to a liquid are cases in point.

Applying the refrigeration fundamentals to the schematic layout, realize that the entire system pictured here is filled with a liquid—generally Freon-12. And never blame anyone for getting intimate with this stuff and calling it "Freon," for its full and "formal" name is *dichlorodifluoromethane*.

COMPRESSOR DOES TWO JOBS

Unlike an air compressor, the air conditioner compressor does a *double* job. It creates a *vacuum* in the evaporator and builds up *pressure* in the condenser.

So with the engine running and the compressor clutch engaged, two actions begin in the air conditioning system. Evaporation of the refrigerant in the evaporator (O) absorbs heat from the air in the car compartment. The hot gas is then sucked into the compressor, and pumped into the condenser out front of the car radiator where it cools and changes back into liquid form.

Just to clear up the foregoing a bit, it would be well to study the illustration of a simplified refrigerating layout which appears on the following page.

One does not have to be a refrigeration engineer to be very helpful to a motorist in an emergency. Failure of a car air conditioner to operate, can be due to any of a number of simple things.

It could be nothing more than a poorly adjusted, worn, or broken compressor belt; the trouble might be a loose connection in the switch that engages the magnetic clutch that drives the compressor. And not infrequently the entire failure is the result of an inoperative evaporator unit fan, the service of which is no different basically than servicing the fan in a car heater. Of course the service problem could be greater; perhaps loss of fluid from the system. And replacing fluid without locating and correcting the leak that permitted the loss, would be just as bad as putting air in a punctured tire without first fixing the tire.

But the best preparation for handling these and other air conditioner problems, is a thorough understanding of the fundamentals of refrigeration. Whether we are concerned with providing cool comfort to a person getting into a car on a hot day or with putting a choice cut of meat in the deep freeze, the *cooling action is the result of removing heat.*

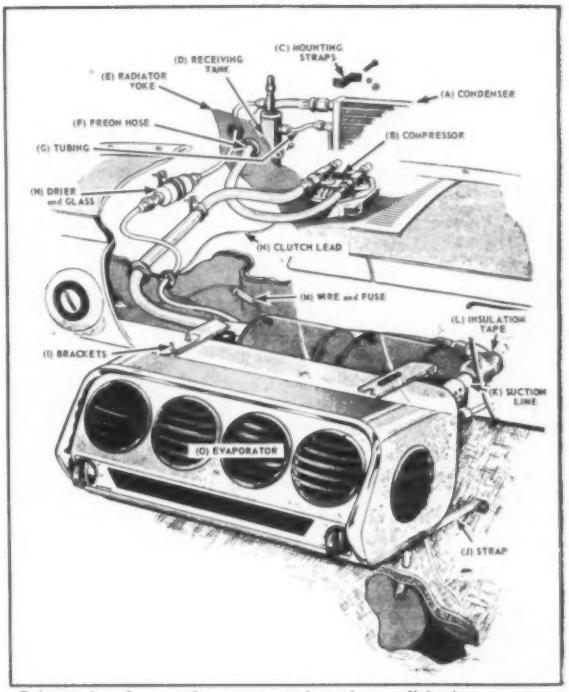
HEAT IS FORM OF ENERGY

Heat is a form of energy. Actually there is no such thing as *cold*. Cold is just lack of heat. All matter exists in solid, liquid, or gaseous (vapor) state. Its physical form is dependent upon the amount of heat that it contains.

We have already mentioned changing water to steam by applying heat; and everyone knows that lack of heat would change the water to ice.

It is good to keep in mind that heat always travels from the warmer object to the cooler; and that adding heat causes expansion.

Heat has two measurements—*intensity* and *quantity*.



Schematic of a modern automotive air conditioning system.

Intensity is measured with a thermometer in degrees. Quantity, known as the British thermal unit or Btu, is defined as the amount of heat required to raise the temperature of one pound of water one degree Fahrenheit.

To illustrate the difference between intensity and quantity, consider two containers filled with one and two pounds of water respectively, each at the same temperature or *intensity*. Obviously there are twice as many heat units in the two pound container as in the one pound container, and it will take twice as long to raise the temperature of two pounds of water the same number of degrees as to raise the temperature of one pound of water.

TWO KINDS OF HEAT

Furthermore there are two kinds of heat—*sensible* and *latent*. Sensible heat changes the temperature of a substance with no change in the form of the substance. Latent heat changes the form of a substance without changing its temperature.

To illustrate, if water is heated anywhere below the boiling point, *sensible* heat absorbed will cause the temperature to rise until the boiling point—212° F.—is reached. At the boiling point, additional *latent* heat will be absorbed to convert the water to a vapor, but the water temperature will remain at 212° F. during the boiling.

For water, one Btu is the amount of heat required to raise the temperature of one pound of water one degree Fahrenheit. So to raise the temperature of one pound of water from 32° F. to 212° F. takes 180 Btu's. Then after reaching 212° F. if the boiling continued until all of the liquid was converted to vapor, 970 additional Btu's would be absorbed to accomplish the conversion.

From this it is seen that when a liquid boils, turning to vapor, it absorbs a great amount of latent heat, yet without changing temperature. Engineers refer to this as "latent heat of vaporization". When the vapor is

(Continued on following page)

condensed the process is reversed, thus the same amount of heat is released in converting the vapor back to a liquid.

This principle of *large heat absorption or release* that occurs when a liquid changes to vapor or a vapor condenses, *forms the basis of modern refrigeration systems.*

VAPORIZATION AND EVAPORATION

In technical discussions watch out for confusion between vaporization and evaporation. *Vaporization* is the conversion of a liquid to a gaseous or vapor state at the boiling point of the liquid. *Evaporation* is the conversion to a vapor state at a temperature lower than the boiling point of the liquid.

For example, if we place a glass of water in a room we know that eventually the water will *evaporate.* This is due primarily to the fact that the air above the water is in constant motion and contains a comparatively small amount of moisture. Nature attempts to produce an equilibrium between the water in the glass and the water in the air. Because of the large volume of drier air and small volume of water, all of the molecules of water will eventually change to vapor and be carried away by the air.

But if we place a sealed cover over a glass of water in the room, the water will evaporate only until the air above it holds all of the moisture that it can contain at that temperature. If the process of evaporation is sufficiently rapid, a noticeable reduction of temperature can be felt. This is known as evaporative cooling.

Any one who ever went swimming on a windy day has had a very practicable and personal demonstration of the effectiveness of evaporative cooling.

The term "hot" is not necessarily associated with a boiling liquid. Freon-12, the refrigerant commonly used in air conditioning systems, boils at 21.7° F. *below zero.* Thus if it were exposed to the air at normal room temperature this Freon-12 would absorb heat from surrounding areas or objects and boil, immediately changing to a vapor.

Saturated vapor is vapor which is in contact with its liquid and which is at the same temperature as the boiling point of its liquid. It remains saturated so long as it is in contact with its liquid. *All vapors used in refrigeration systems are saturated vapors.*

Super-heated vapor is vapor which has its temperature increased above the boiling point of the liquid from which it came.

Compressing a vapor increases its temperature and conversely, expanding a vapor decreases its temperature. A hand tire pump, for example, will become warm when pumping air into a tire due to the heating of the air as it is compressed. Letting air out of a tire valve has a cooling effect on the valve.

Any vapor can be liquified by squeezing or compressing it *if sufficient pressure is exerted.*

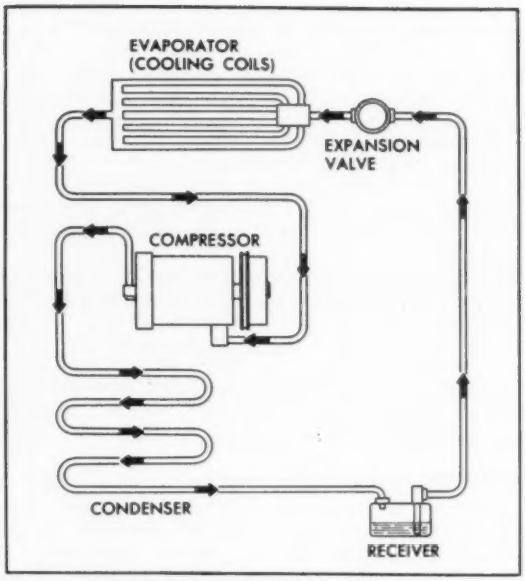
ATMOSPHERIC PRESSURE

All pressure, regardless of how it is produced, is measured in pounds per square inch (psi).

Atmospheric pressure is pressure exerted in every direction by the weight of the atmosphere. At higher altitudes air is rarified and has less weight and hence, less pressure. At sea level, atmospheric pressure is 14.7 psi.

Any pressure less than atmospheric is known as a *partial vacuum,* more commonly called a *vacuum.* A perfect vacuum, or region of no pressure, has never been mechanically produced.

Gauge pressure is used in refrigeration work. Gauges are calibrated in pounds (psi) of pressure and inches of vacuum. At sea level "0" lb. gauge pressure is equivalent to 14.7 lb. atmospheric pressure. Pressure *greater* than atmospheric is measured in pounds (psi) and pressure *below* atmospheric is measured in *inches of vacuum,* sometimes called *inches of mercury.* The "0" on the gauge will always correspond to the surrounding atmospheric pressure, regardless of the elevation where the gauge is being used.



Simplified refrigeration system.

BOILING POINT INFLUENCED BY PRESSURE

Water and refrigerant liquids have a definite boiling point. This, however, is influenced by the pressure applied. Water, for example, will boil at 212° F. only at sea level atmospheric pressure. If the pressure is increased the water will not boil until a higher temperature is reached. Freon-12, which would normally boil at 21.7° F. *below zero* if exposed to the atmosphere, can be prevented from boiling if it is kept under high pressure. Conversely, if the pressure is decreased, the liquid will boil at a lower temperature.

When the pressure of a vapor is increased, the temperature at which it will condense is also raised.

A definite pressure and temperature relationship exists in the case of liquid refrigerants and their saturated vapors. Increasing the temperature of a substance causes it to expand. When the substance is confined in a closed container, the increase in temperature will be accompanied by an increase in pressure, even though no mechanical device was used. *For every temperature, there will be a corresponding pressure within the container of refrigerant.*

Pressures are indicated in gauge pressure, either positive pressure (above atmospheric) in pounds or negative pressure (below atmospheric) inches of vacuum. Thus if a gauge is attached to a container of Freon-12 and the room temperature is 70°, the gauge will register a 70 lb. pressure; in a 100° room, the pressure will be 117 lb.

All automotive air conditioners take advantage of the principles just described.

Now with a more thorough appreciation of the action within a car cooler or air conditioner, let's review what

(Continued on page 44)

AUTOMOTIVE SERVICE EDUCATION

College-trained mechanics

Modern dealer and independent service shops badly need men with the "tech know-how" to use precise, versatile equipment and instruments on today's complex cars. Where will those with a natural "knack" get the broad, intensive training to translate aptitude into valuable, specialized industrial skill?

• COLLEGE EDUCATION FOR a career in automotive servicing? Many eyebrows rise at the suggestion of an advanced education for a "blue collar" job. Colleges and universities are for the children of the rich—runs the general thinking—or anyway, only for the rich and such young minds as could be molded into scientists and engineers. Here, though, popular opinion is running far behind fact.

For, one of the best examples of helping meet the automotive industry's acute need for many more highly skilled service men, is a college. Ferris Institute, located at Big Rapids, Mich.—in America's automotive heartland—is turning out increasing numbers of specialists in Automotive Service, Auto Machine Shop, and Auto Body and Fender Repair and Painting.

These holders of Certificates, earned in the Trade and Industrial Division of Ferris' School of Applied Arts and Specialized Education, are winning an eager reception in the field. As for the soundness of the Institute's instruction and the progress of those who receive it, Ferris is rather proud of one of its better known graduates—Harlow H. Curtice of General Motors.

ELEMENTS OF SERVICE EDUCATION

Many a man with a natural "bent" for the mechanical arts—whether already doing shop work, or simply looking for the field where this valuable talent will "pay off" best in both income and personal satisfaction—might well consider the "case" for college-level study. Shop management, too, has good reason to familiarize itself with the facts about what's being taught in such courses, how well-equipped the graduates are for day-to-day service procedures and problems.

Who's taking this kind of training . . . what are they learning . . . how much does it cost and how long does it take to complete a sound basic course? These are key facts to shop management and potential student alike. We can get a working acquaintance with one representative type of advanced service education by "tearing-down" the Ferris' automotive programs,

(Continued on following page)

Home of the Automotive Service Program at Ferris — an ultra-modern installation of 16,000 square feet.

Mechanic Training . . . CONTINUED

One of the most important fundamental factors is the "climate" in which the instruction is given, the nature of the educational institution itself. Ferris came into being in 1884, founded by Woodbridge Nathan Ferris, and known as "Big Rapids Industrial School" for a few months. It soon became "The Ferris Industrial School," and remained so until renamed "Ferris Institute" in 1899. By act of the Michigan legislature in 1949, Ferris became a state college, a memorial to its founder who served as Governor and as a U. S. Senator. As the state college with primary emphasis in practical, vocational and technical education, Ferris gears its programs to equipping the student with the "skills, understandings and abilities to meet the exacting requirements of income-producing positions."

REALISTIC ENTRANCE REQUIREMENTS

The Trade and Industrial Division (within the School of Applied Arts and Specialized Education), which offers the automotive courses, is realistic in its entrance requirements. Admission is granted on the basis of graduation from high school or equivalent; or "sufficient maturity, earnestness of purpose and aptitude to profit from the instruction." For those who find themselves a little short of the required knowledge in science and math, the Institute's High School Division provides a course that will make up the deficiency—and which may be taken while carrying the work in the automotive subjects.

Beginning students whose backgrounds show that they can handle the more advanced classes, are credited with previous education; and started in at the level of advanced work in their specialty.

According to the faculty, Ferris could best be described as an "average man's" college financially. Many of the students work during their attendance, to defray the expenses. The student body also includes many veterans, living on the campus with their families, who are attending under G. I. Bill of Rights benefits.

Geographically, the student body represents a cross-section of the State of Michigan—with every county "accounted for" among current enrollees. These, of course, cover many vocations other than automotive; since Commerce, Pharmacy, General Education and a broad range of additional technical subjects are also offered. Other States, and a few foreign countries round out the enrollment, a few being admitted each year.

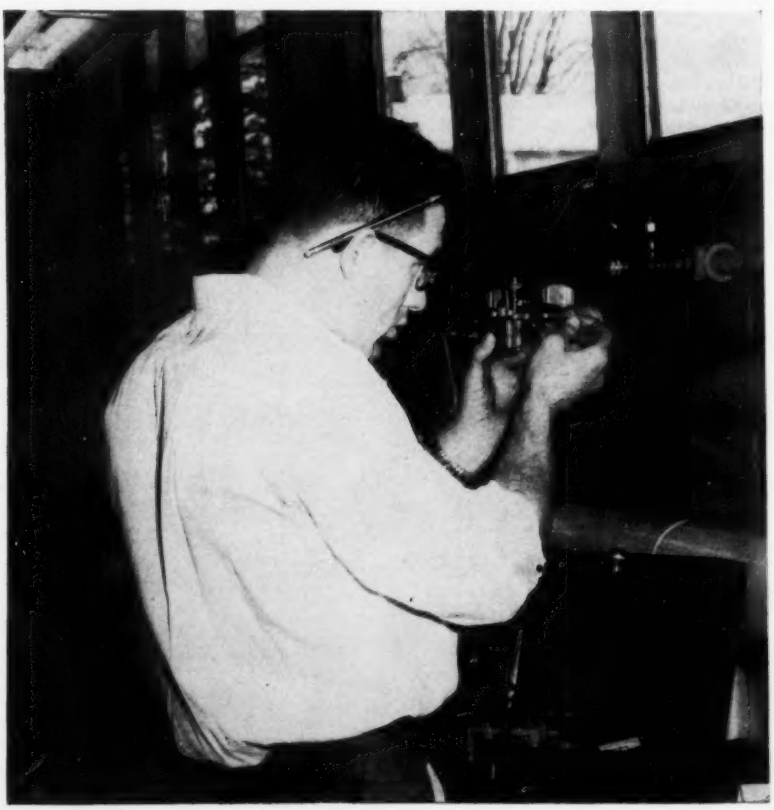
TIME AND COST

Depending on the field in which he chooses to specialize, the prospective automotive service man can get a comprehensive education at Ferris in from one year to two years. Ferris is organized on the quarter system, with four 12-week quarters constituting the calendar year. One quarter, which is optional for the students, is held through the summer months.

Ferris' Automotive Service program is presented in six quarters, and thus can be completed in a year and a half by attending consecutive quarters. Auto Machine Shop requires four quarters; and Auto Body and Fender Repair and Painting, six quarters.

Today's student at the Institute can manage on surprisingly little money, attending full-time and living in a college dormitory (which is required for all single students living away from home). A reasonable estimate for room, board, books, tuition and incidentals for a resident student, is $900.00 for three quarters.

Tuition runs approximately $62 per quarter; and room



Adjusting carburetor float before complete reassembly of the part. Carburetion gets heavy emphasis in the 300 hours on tune-up required of Servicing program students.

Camshaft grinding is one of the skills that must be mastered by those who spend some 1700 hours becoming auto machinists.

and board, $204. Necessary school supplies vary with the particular course, naturally, but will fit within the $900 quoted in almost all cases. Non-resident students (whose parents or guardians do not reside in Michigan at the time of initial registration—unless the student himself has established Michigan residence) pay $50 more per quarter for tuition. Married couples live on the campus in college-owned "house-keeping" apartments, which rent for $60-65 per month.

Based on these budgets, a single man may acquire a thorough education in Automotive Service (six quarters) for from $1800 (as a resident student) to $2100, on the average. If he specializes in body work, the cost will be the same; while for Auto Machine Shop, it should run from about $1200 for a resident, to $1400, non-resident.

HELPING HANDS

True to its founding concept of throwing wide the doors of opportunity to those persons with ambition and willingness to work, Ferris Institute has the full complement of financial aids to students. In addition to student loan funds, which advance money on the basis of need, scholarship and character, there are a range of grants-in-aids and scholarships. None of the scholarships, incidentally, requires athletic ability—despite the fact that the Institute's recently expanded "plant" includes a large athletic field and a gymnasium that seats 1200.

The college's Bulletin for 1957-58 lists a number of scholarships available to students in the automotive programs. Several others have been contributed by interested industry groups. Most of these cover the tuition and are granted to students of proved ability and financial need.

Industry-endowed scholarships are only one indication of the close relationship between the Institute and the technical fields it serves. Generally speaking, the faculty makes every effort to provide opportunity for companies, engineering and trade groups to present their "stories" directly to automotive students. All individual requests for information on scholarships are handled by the Faculty Committee on Scholarships, Ferris Institute, Big Rapids, Mich.

Another phase of student assistance, is the activity of the Dean of Students in helping find part-time jobs for those who must "go that route" to meet expenses. Employment opportunities may be provided at the college, or in stores, homes and factories within surrounding communities. Schedules that fit the outside work load to the study load, have been carefully drawn up—to permit matching scholastic ability and earning requirements, and assuring the student his full "money's worth" in education.

MATCHING METHODS TO "MISSIONS"

In these days of great fervor and furor about the kind of education America is giving it's young, it's probably important to emphasize one particular fact about the "college-trained mechanic" we're discussing here. The instruction he receives does measure up to "academic" standards—Ferris is fully accredited—but there's nothing "abstract" or "long-hair" about it. The objectives, as listed in the school's bulletin are to cover both the theory and the shop experience necessary to gain occupational competence— the ability to make a living doing a good job in the field of work the student has chosen.

To reach this goal, the instructors stress mastery of the necessary skills of the trade, their use in practical problems; correct habits of work and safety; economic, social and legal principles that play a part in industrial society. Instructors are chosen for their own ability to do

(Continued on page 20)

AUTO MACHINE SHOP

First Quarter	Hours Per Week
Orientation	1
AM-161—Auto Machine Shop I	15
MT-181—Machine Operations and Set-Up	10
Communication Skills 51—Communications I	3
G-101—Basic Math	5
H. & P.E. 121—Health and Physical Ed.	3
	37
Second Quarter	
AM-162—Auto Machine Shop II	25
W-183—Combined Welding	4
Communication Skills 52—Communications II	3
H. & P.E. 122—Health and Physical Ed.	3
	35
Third Quarter	
AM-163—Auto Machine Shop III	25
G-130—Foremanship Training	3
Pol. Sci. 61—Political Science	5
H. & P.E. 123—Health and Physical Ed.	3
	36
Fourth Quarter	
AM-261—Auto Machine Shop IV	25
AM-271—Jobber Management	4
Soc. Sci. 51—Men and Society I	5
	34

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1. Step-by-step spark plug service and installation procedures
2. How to service the ignition system
3. The spark plug's function in the ignition system
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5. How spark plug heat range is determined
6. Latest information on Auto-Lite Spark Plugs with Power Tip
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8. Heat range charts for all types of plugs
9. Suppression of ignition interference for two-way radios
10. Construction features of various spark plugs

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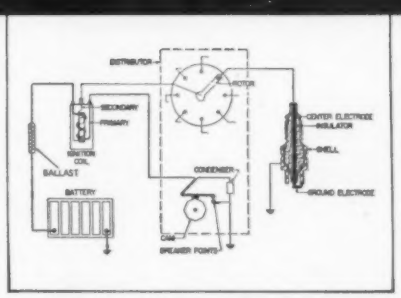
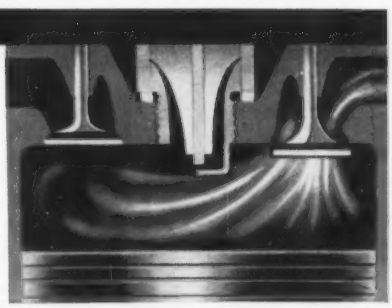
SPEED UP YOUR SPARK PLUG SERVICE on *all* makes of cars with latest information on removal, testing, cleaning, and adjusting plugs.



LEARN HOW SPARK PLUGS FUNCTION in the ignition system. You get the complete story of the spark plug's relationship to the other ignition components.



LEARN THE DIFFERENCE between Auto-Lite Spark Plug with Power Tip and ordinary spark plugs. Illustrations show you how Power Tip "fires up" modern engines for top performance at all speeds.

AUTOMOTIVE SERVICE

First Quarter	Hours Per Week
Orientation	1
A-161—Basic Auto	25
MT-172—Basic Metal Shop	4
Communication Skills 51—Communications I	3
H. & P.E. 121—Health and Physical Ed.	3
	36
Second Quarter	
	25
A-162—Engine Re-building	5
G-101—Basic Math	3
Communication Skills 52—Communications II	3
H. & P.E. 122—Health and Physical Ed.	
	36
Third Quarter	
A-164—Front End Alignment and Brakes	22
A-153—Basic Electricity	5
Soc. Sci. 51—Man and Society I	5
H. & P.E. 123—Health and Physical Ed.	3
	35

Fourth Quarter	Hours Per Week
A-261—Tune-Up	25
G-112—Mechanics and Heat	7
Pol. Sci. 61—Political Science	5
	37
Fifth Quarter	
AT-262—Auto Testing I OR	
A-271—Alignment and Collision OR	
A-263—Automatic Transmissions	25
W-183—Combined Welding	4
G-130—Foremanship Training	3
Elective	3
	35
Sixth Quarter	
AT-263—Auto Testing II OR	
A-271—Alignment and Collision OR	
A-263—Automatic Transmissions	25
A-272—Service Management	4
R-181—Air Conditioning	4
Elective	3
	36

Mechanic Training . . . CONTINUED

the work they teach, as well as for their broad knowledge and experience in the automotive service field.

Classes vary in size, according to the subject and its requirements for time spent with each individual student. For instance, 10 students is a normal "load" for an instructor in Auto Machine Shop; compared to 25 in Architectural Drafting.

"Classrooms" would hardly go by that name to the general public. Those of the automotive groups occupy the center wing of the new, E-shaped Trade and Industrial Center—a 75,000-foot modern structure, "loaded" with the most-up-to-date equipment of the type found in industrial establishments. As an example, the Automotive Service instruction area covers 16,000 square feet; includes an ultra-modern garage, laid-out on the same scale and operated under the same procedures as the service department of a high-volume dealership.

Front end instructor Frank Jones says of this "classroom," that it "takes in anything." Actually the entire quota of student work done there comes right off the street. The local County Sheriff says of the students, "These guys are so good, we bring all our cars in here for servicing."

Describing student projects, Jones said: "Right now we're working on a 1956 Buick that was hit on the side and rolled a coupled of times. It's going to take a stretch pull, hold-down pull, and sway pull, and a complete overhaul of the front suspension.

"When we get all the measurements within specs, we'll run it on the machine and give it a complete alignment check."

The heavy repair section of the automotive area is fitted with special two-post hoists, to speed up removal of such units as automatic transmissions. Another popular installation is a special cleaning room, where live steam and agitator tank cleaners are used on all parts to be serviced. One "plus" here, from the instructors' viewpoint: by becoming familiar with this equipment, and working on clean parts and in such surroundings, the students learn the value of personal cleanliness.

PROGRAM INGREDIENTS

It's apparent that the environment suited to the service field—at its best—surrounds the students. And what's

AUTO BODY AND FENDER REPAIR AND PAINTING PROGRAM

First Quarter	Hours Per Week
Orientation	1
B-161—Body Shop	25
W-183—Combined Welding	4
Communication Skills 51—Communications I	3
H. & P.E. 121—Health and Physical Ed.	3
	36
Second Quarter	
B-162—Body Shop	25
W-192—Combined Welding	6
H. & P.E. 122—Health and Physical Ed.	3
	34
Third Quarter	
B-163—Body Shop	25
G-101—Basic Math	5
Communication Skills 52—Communications II	3
H. & P.E. 123—Health and Physical Ed.	3
	36

Fourth Quarter	Hours Per Week
A-271—Alignment and Collision	25
G-136—Small Business Management	3
R-181—Automotive Air Conditioning	4
Elective	3
	35
Fifth Quarter	
B-262—Body Shop	25
A-272—Service Management	4
Soc. Sci. 51—Man and Society I	5
	34
Sixth Quarter	
B-263—Body Shop	25
Pol. Sci. 61—Political Science	5
G-130—Foremanship Training	3
Elective	2
	35

done there is equally well-calculated to prepare one for service-shop realities. The students put in a pretty "solid" seven-hour day, five-day week on the subjects listed in the accompanying three boxes: Automotive Service; Auto Machine Shop, and Auto Body and Fender Repair and Painting. Let's translate these dry curricula from the Bulletin language into their more interesting results—the background a Ferris Certificate winner takes with him when he has completed a course and is ready to sign-up for a job with the dealer or independent service shop:

Automotive Service—This Certificate holder comes to the service department with a background that includes: 300 hours in Basic Auto Work, where he becomes familiar with the components of the car, does shop work on mock-up units and light service jobs—covering a variety of typical orders.

He also has 300 hours to his credit in Engine Rebuilding procedures and operations—boring cylinders; grinding valves, fittings, piston and piston pins; other required work, done on customer cars as well as practice units. Add to this 300 hours in engine tune-up theories and practices, and 264 hours of comparable training and experience in brake and front-end alignment. Those are the required basic "technical offerings" the student must take and master.

Beyond this, the prospective Automotive Service specialist has options. In the Fifth and Sixth quarters he can take 600 hours more work in auto testing—stressing diagnosis and the use of advanced instruments. Or this 600-hour segment of his class work can be split between Automatic Transmissions and Alignment-and-Collision, 300 hours each.

Backing up the knowledge thus acquired, and rounding out the student's understanding of both the work and the field are: 60 hours in basic math and the same amount in basic electricity; 48 hours each on air conditioning, basic metal shop, service management; 84, mechanics and heat; 36 hours—equivalent to a week's uninterrupted work—in foremanship training and in combined welding, and twice that length of time on communications. Finally, the student will put in 36 hours in the fifth quarter and the same in the sixth on electives—choosing such special courses as add to know-how in the work he likes best.

Auto Machine Shop—To become an automotive machinist, the student completing this program will spend nearly 1100 hours using standard and special machine shop equipment, in rebuilding engines and their component parts. He'll learn to grind crankshafts and camshafts, machine the block, recondition cylinder walls, hone or bore rods, hone spindles and lap pistons; and perform the other major operations required for this work. Some 120 hours of his class time will be devoted to set-up and machining techniques themselves; and he will be required also, to master such allied work as tune-up, starter and generator service.

Prospective automotive machinists receive the 60 hours basic math, 36 foremanship training, 72 communications skills and 48 in combined welding that go into the Automotive Service students' training. An "extra" is 48 hours of Jobber Management, to give the picture of parts purchasing, stock control and distribution channels.

Auto Body, Fender Repair and Painting—With 1500 hours of body shop built-in, this six-quarter program takes the enrollees from the basic theories in shrinking, leading, stretching, etc., through to the restoration of a complete wreck to its original contour and finish. Along the way, there's intensive instruction and practice in all key operations: and that includes the construction, operation and care of the spray gun and equipment; paint mixing, as well as application, both enamel and laquer; progressively more advanced experience on "live" cars; glass work. Not to miss a good trick of teaching, the set-up and equipping of a body shop, and estimating with an eye on winning the business of insurance firms as well as auto owners, are covered.

Naturally enough, the body program incorporates 300 hours on alignment and collision, and 180 hours combined welding. In addition to 48 hours on service management, and 36 on foremanship, there are 36 devoted to small business management, and 48 to automotive air conditioning. The 72 hours on communication skills are given in this program, as in both the other automotive instruction categories.

THE STUDENTS-EYE VIEW

Taken individually or as-assembled, the parts of a college-level education in automotive servicing seem demanding—and are. Yet, those who take the plunge out of a genuine interest in the field, don't complain.

(Continued on following page)

An instructor in body work analyzes the job for his students before letting them pitch into a typical task. Instructors must be able to "practice what they preach."

Mechanic Training . . . CONTINUED

Says one Ferris student, of the math: "I quit school in 10th grade, mostly because I couldn't get math through my thick head. The 'pi-r-square' bit was really just so much Greek to me—didn't seem to have any bearing on making a living.

"Here, though, I'm handling math as easily as rolling off a log. Guess it's the way they teach it—tied-up directly to the mechanics and making the tough jobs easier. Never thought the day would come, but I really am *enjoying* math."

Dean Jon P. Adams of the Trade and Industrial Division commented: "There's no reason for anyone coming to Ferris to fear math—even if he has a weak formal background. We bring it down to earth, and teach only what applies to the course."

Another student, who had attended one of the recently-launched short specialty courses for working mechanics was equally enthusiastic. After a week of Frame Straightening last July, Stan Willis exclaimed: "You can't believe what a school like this can do for a person unless you actually see it and live with it!

"Our instructor had practical experience in front end and frame work, and he knew how to put you at ease. At the same time, he knows how to get you to study and learn. In one week he had us caught up on the things we'd forgotten, and taught us much more.

"We had a week in pleasant surroundings, a fine room and meals, an excellent course, plus a graduation lunch—all for $65. Best bargain in the world!"

PROFILE OF PROGRESS

Over the past five years, Ferris Institute's enrollment has risen more than 25% each year—with the Trade and Industrial Division more than keeping pace (T&I, 261 students in 1956-57; 368, '57-58). The percentage of flunks, according to the faculty, is very low: one reason, counseling and guidance that switched the student from a program in which he does badly, to one where his aptitude and ability will give him a better chance for success.

For the most part, the school records show, the grads go directly into the trade for which they've trained—a real point of difference from the picture in many, more "academic" educational circles. Industry has come to accept the graduation Certificate, school officials report, to the point where many firms are now contacting the college about hiring graduates in specific study programs.

Obviously, the college-level automotive trainee has much to "shoot for." Among other inducements, too, are the Institute's own Awards: one is presented annually, for example, to the outstanding graduate in each department of the Trade & Industrial Division.

Graduate job placement help is provided by the Institute, through the instructors. While of course, there are no guarantees given enrolling students regarding chances for employment upon graduation, the school has never been able to fill the demand. It's not unheard of for outstanding students to go directly into supervisory positions.

FINAL RESULTS UP TO STUDENT

Naturally, the "fruits" of college-level education depend a lot on how the student applies himself at the school, and on the post-grad job. Here, though, is the case history of one who really applied himself:

Elden Britle entered Ferris as a beginning student in February 1954, out of a farm family home background and following two years in the Army. Although he'd had no previous experience in industrial auto service work, he received some experience in the Army motor pool.

Making good use of his time in school, Elden finished as an Honor Award student in Automotive Service in June, 1955. His first post-graduate job was with a Buick-Chevrolet agency, where he began as a mechanic and soon acquired additional, service management responsibilities.

After six successful months on that first job, he received a better offer, and joined another dealer—who was starting his agency with one mechanic—Elden Britle. Now, after 27 months in that position, he is Service Manager, with three mechanics under him.

The most striking evidence, perhaps, of Elden's successful record with his present employer is that of the three mechanics working in his department, two are also Ferris Institute graduates.

Students learn the value of thoroughness—thoroughly. Here, rebuilt engine gets checkout of its performance in all respects by means of a "road test inside the shop."

MoPar
PARTS & ACCESSORIES

Oriflow Shock Absorbers

EXTRA TOUGH

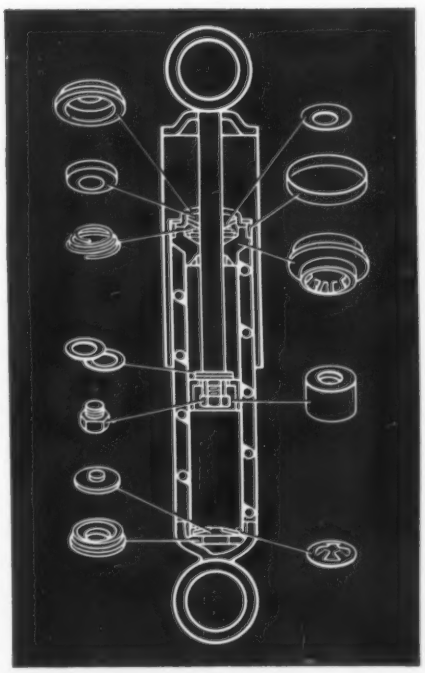
Chrysler engineered *hydraulic control* makes a simpler shock construction to take your customers' roughest treatment

Better hydraulic *control* is the reason behind MoPar Oriflows—and simpler, longer life construction is the result. That's a solid fact, for solid profits.

You—and your customers—will feel the difference Oriflows make. Fluid flow does the job *naturally*, by completely cushioning *all* bumps, to give a smoother ride under *all* conditions.

The radically different design of MoPar Oriflows uses 10 fewer parts than conventional types. This greater simplicity means greater durability—longer life. Installing Oriflows means satisfied service customers for you.

MoPar Oriflows are quick and easy to install—come in convenient packages. Made and *guaranteed* by Chrysler Corporation. You get immediate delivery from your MoPar wholesaler or your Plymouth, Dodge, De Soto, Chrysler, Imperial, or Dodge Truck dealer.

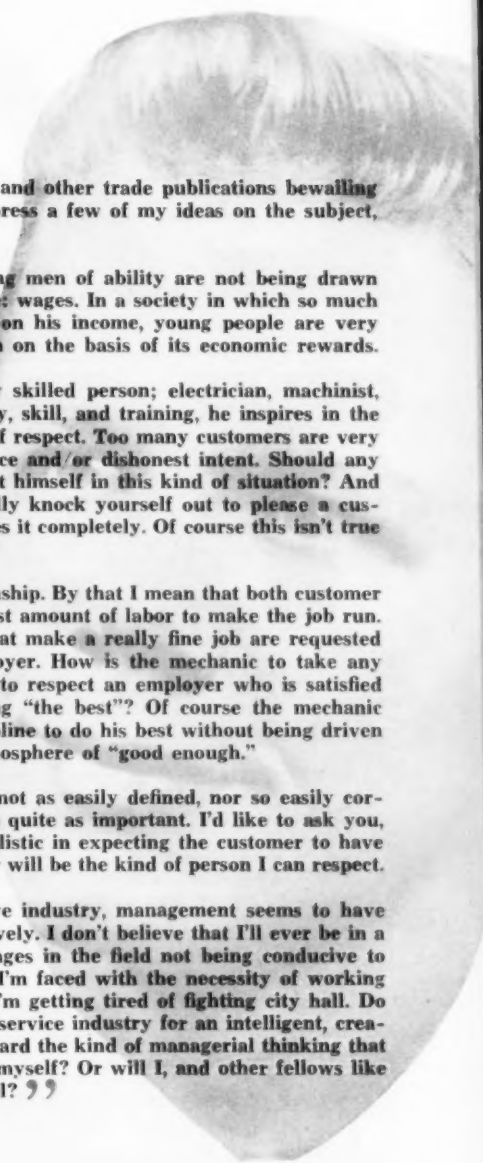


Exploded view shows the amazing simplicity of the MoPar Oriflow engineering principle. These few parts do the entire job—more effectively, longer.

MoPar Division, Chrysler Motors Corporation, Detroit 31, Michigan

Superior service should be a "two-way street"

the mechanic says



"I've read with interest editorials in ASD and other trade publications bewailing the lack of skilled mechanics. I'd like to express a few of my ideas on the subject, and ask you for an opinion.

I think that one of the reasons that young men of ability are not being drawn into the field is rather obvious, at least to me: wages. In a society in which so much of the judgment of a man's worth is based on his income, young people are very likely to select their life's work pretty much on the basis of its economic rewards.

A good auto mechanic must be a highly skilled person; electrician, machinist, what-have-you. But in spite of all his ability, skill, and training, he inspires in the car owner-customer the most singular lack of respect. Too many customers are very quick to accuse the mechanic of incompetence and/or dishonest intent. Should any young man in his right mind deliberately put himself in this kind of situation? And the clincher of course is that when you really knock yourself out to please a customer he merely takes it as his due, or ignores it completely. Of course this isn't true in every case, but it is the general rule.

Further, there is no demand for craftsmanship. By that I mean that both customer and employer want the cheapest job, the least amount of labor to make the job run. No extra effort, none of the little touches that make a really fine job are requested by the customer or demanded by the employer. How is the mechanic to take any great deal of pride in his work? How is he to respect an employer who is satisfied with "good enough," rather than demanding "the best"? Of course the mechanic should have enough maturity and self-discipline to do his best without being driven to it, but it's hard to do your best in an atmosphere of "good enough."

Of these three things the latter two are not as easily defined, nor so easily corrected, as the first, but to my mind they are quite as important. I'd like to ask you, Mr. Ikert, whether you feel I'm being unrealistic in expecting the customer to have respect for me, and hoping that my employer will be the kind of person I can respect.

In its concern to survive in a competitive industry, management seems to have lost the ability to think originally and creatively. I don't believe that I'll ever be in a position to go into business on my own, wages in the field not being conducive to the accumulation of investment capital. So I'm faced with the necessity of working for other men, at least for some time. But I'm getting tired of fighting city hall. Do you think that there is a future in the auto service industry for an intelligent, creative young man? Is the industry moving toward the kind of managerial thinking that will solve problems like these for men like myself? Or will I, and other fellows like me, go on beating our heads against the wall?"

How prevalent is this condition
. . . how common this question?

How will it be answered?

Correcting low oil pressure

Since the life blood of any internal combustion engine is its lubricating oil, it is only logical that the engine's "pulse" or pressure be checked from time to time to be sure it is up to normal.

● SERVICE PERSONNEL and many car owners know that engines cannot run very long—not over a few minutes—without a suitable supply of oil being pumped to bearings, and splashed on cylinder walls. Therefore, if for some reason the lubricant supply fails, something must be done, and done very quickly.

Obviously the first thing to do, is to stop the engine, if it has not already "stuck" by itself. The next move is to find out *why* oil pressure dropped, so necessary corrections can be made.

An unusual case of dropping oil pressure is recalled. A motorist was driving across the wide open spaces in Utah, when, thirty-five miles from the nearest town, a big collie dog decided to cross the road in front of the car. The car was going at about 70 mph. The driver tried to avoid the dog, but could not and the car hit the dog, the latter being rolled under the car. The driver stopped to see what damage was done, if any, to the car, but none was noticeable.

After driving about 10 miles, the driver noticed that the oil pressure was down to about half of normal. The car, a '55 Mercury, was equipped with an oil pressure gauge. The driver, who was well informed about automobile engines, listened carefully for any unusual noises in the engine and watched the temperature gauge for rising temperature. As noise nor temperature rise was not observed, he kept on going, but in another 10 miles, the pressure was down to about 10 lb. Still there was no sign of trouble in the engine so the driving was continued at reduced speed. Finally after another 15 miles a small town was reached and the car was driven into a service shop.

Inspection showed that the dog, in rolling under the car, had apparently hit the end of the crankcase breather pipe, bending it backward and distorting the seat against which the breather air filter case rests. This allowed oil seepage, losing 3 of the 5 quarts of oil in the pan. Fortunately the needed new parts were obtainable and were put in place. Three quarts of oil were added to restore the correct oil level, and the car was again on its way. There was no other apparent damage

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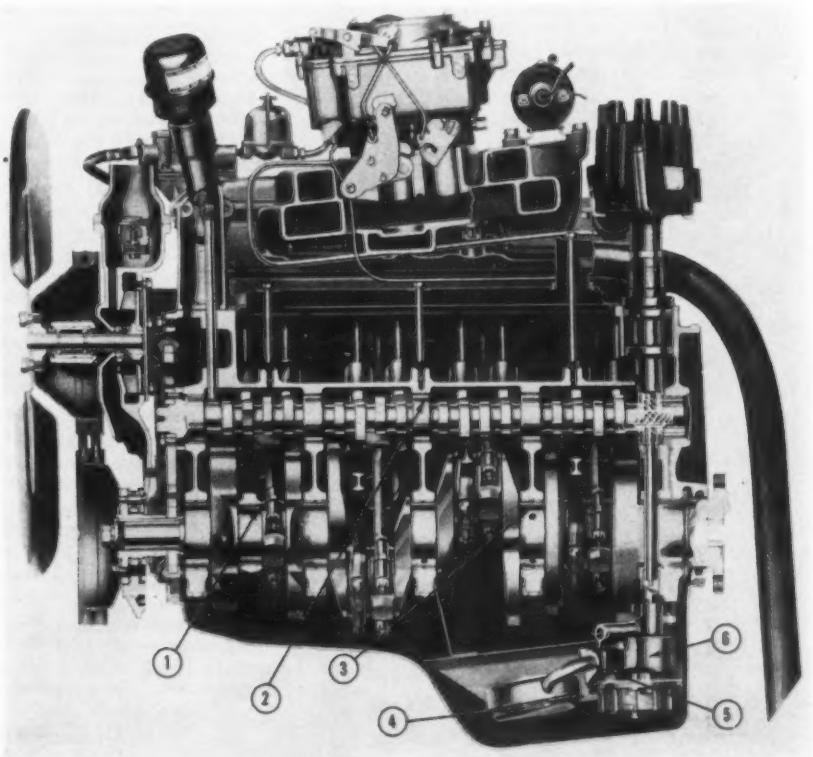


Section through overhead valve V-8 engine, showing locations where trouble might contribute to low oil pressure: 1. Loose rod bearings; 2. Worn camshaft bearings; 3. Loose main bearings; 4. Clogged oil screen; 5. Air leak at oil pump inlet; 6. Worn oil pump or pump pressure control valve held off seat.

By GUY F. WETZEL
Technical Editor

Oil Pressure . . . CONTINUED

done, as during the rest of the trip no oil was used and the engine performed normally.

This experience emphasizes the value of both the oil pressure and temperature gauges. Some cars do not have either an ammeter or oil pressure gauge and if the car in question had not been equipped with an oil pressure gauge to signify oil leakage, serious damage could have been done to the engine. If the trouble had not been corrected in time it is unlikely that the next town (40 miles away) could have been reached in time to avoid a ruined engine.

ENGINE WEAR A SLOW PROCESS

A fact which we sometimes lose sight of is that as soon as a new car leaves the dealer's stock and is put into service, it starts to wear out. Fortunately the wearing out process is slow, as we know from experience an automobile which has been properly serviced and maintained, will be good for 40 to 60 thousand miles of relatively trouble-free driving. This statement should be modified to take into account the kind of driving that is done, and will only be true when the vehicle is not abused. But normal wear does take place on all moving parts.

The greatest rate of wear is generally between the piston rings and cylinder walls. The next most rapid wear is at the rod bearings, then the main bearings.

Bearings affect the oil pressure in the lubricating system since the clearance between the bearings and journals at the main bearings and crank pins, as well as the other parts supplied with oil under pressure, determines the rate of oil flow. The lubricating system is balanced so that with an oil pump in good working order, the pump will supply enough oil to adequately lubricate all moving engine parts that require lubrication. This is true up to the point where bearing clearances, due to wear, gradually increase enough to permit excessive amounts of oil to get through the clearance spaces. When this condition is reached, the oil pump may not have enough capacity to maintain the normal oil pressure under working temperatures.

In some cases one rod or main bearing may burn out or fail due to wrong installation, fatigue, or other cause, allowing an excessively large clearance space for the oil to flow through. This will lower the oil pressure and also, by diverting the normal oil flow away from other bearings, may starve them of oil and cause failure.

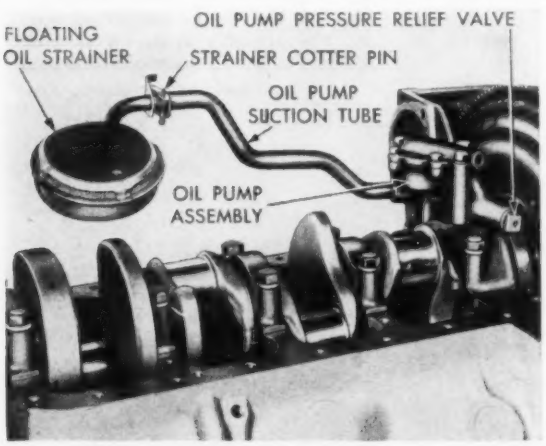
BEARINGS METER THE OIL

While this is not generally realized, the bearings actually meter the oil that flows through or past them. This might be considered as being similar to an orifice, since the bigger the clearance, the greater will be the amount of oil that will flow through it at a given pressure.

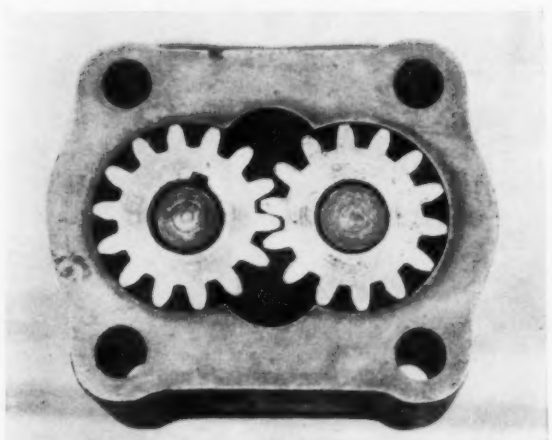
The pressure relief valve acts to maintain a uniform pressure by by-passing all the oil that does not flow through the bearing clearances. If the bearing flow becomes great enough to equal pump capacity, no oil will flow through the by-pass relief valve. As the bearing wear increases the flow through them has less flow resistance, and the oil pressure gradually becomes lower. Here again the value of the oil pressure gauge is emphasized. A warning light only says there is either pressure or no pressure, but gives no other information, the absence of which might lead to trouble without the operator being aware of it.

An indication of excessively worn bearings will be given in an engine that is quiet when started up cold, but becomes noisy from pounding bearings when it gets up to operating temperature and heavy loads are applied, such as rapid acceleration or climbing a steep hill. This is due to the fact that many engine oils thin out to a lower viscosity as they become heated. However, with a good grade engine oil, particularly a good quality 10W-30 or 20W-40, whichever is suitable, considerable bearing wear can take place without bearings becoming too noisy. The big advantage of the so-called "All-Weather" oils (10W-30, etc.) is that viscosity modifiers are added so that the viscosity changes a relatively small amount from a cold temperature to engine operating temperature. Thus, oil pressure will remain higher with moderately worn bearings than with oil which thins out considerably when heated.

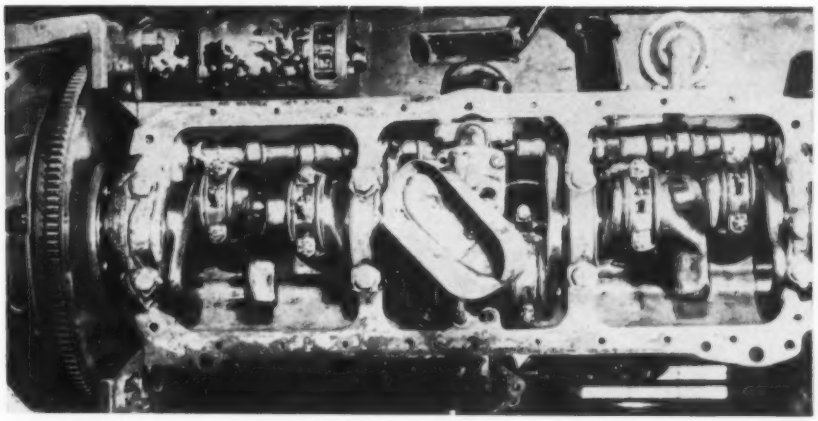
The drop in oil pressure from worn bearings takes place quite slowly so that it may not be noticed by the operator of the car. A more noticeable indication of worn bearings is the need for oil replacement at frequent intervals due to the fact that the bearings pass more oil than can be han-



Oil pump assembly and floating inlet. Any air leak in the connections may cause loss of oil pressure.



Typical gear pump used in many lubrication systems. The same type is used in power steering pressure systems. Oil trapped between the gear teeth is squeezed out by the meshing teeth.



"Worm's-eye-view" of a six-cylinder engine showing location of oil pump inlet which sometimes gets clogged up with sludge, shutting off oil supply.

dled by the rings, and an excessive amount gets up into the combustion chamber and is burned. However, there are other causes of low oil pressure, some of which will drop the pressure quickly and others that show up more gradually, but still faster than with worn bearings.

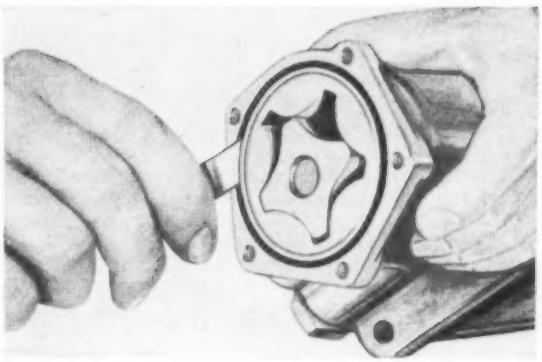
OIL PAN MUST BE KEPT CLEAN

Occasionally water will get into the engine oil pan. This may come from a slight leak in the head gasket, from a crack in the head or block, or from condensation in the crankcase. Water in the oil pan creates a sticky sludge with oil that has seen some use. This sludge is extremely undesirable because it coats the inside of the crankcase and collects on the oil pump screen. When enough of this sludge accumulates on the oil pump screen, it will shut off the oil supply to the pump and consequently restrict the oil supply to the engine.

If and when this occurs, the engine will quickly become noisy and lose power, so that the operator will know at once that something is wrong. He should immediately stop the engine, even though the car may be out on the road. This will usually require towing to the nearest service shop, but is far better than having a ruined engine, or at best an expensive engine job. The correction needed is to remove the oil pan and clean the oil screen; then before starting, find out where the water came from and correct the cause of the trouble as far as possible.

If the water comes from condensation as the car is warmed up in use and then allowed to cool under high humidity conditions, or accumulates in an engine that is used only occasionally in cold weather, about the only thing that can be done is to drain the oil frequently—possibly every 500 miles of driving—and use a good oil specified for the engine.

Sludge may be formed in the crankcase from the use of low grade engine oil or from deficient or defective crankcase ventilation. The filter element in the crankcase vent on some cars may become so clogged, due to neglect, that gases cannot pass through, and this contributes to sludge formation. A disproportionate amount of slow speed driving and short runs during which the engine seldom gets up to normal operating temperature also contributes to sludge formation.



Variation of the gear type pump with inner rotor and outer rotor, as used on some Ford engines. Clearance between outer rotor and housing should not be over .006"-.007".

Sludge which may be formed in the oil pan may have another bad effect by possibly obstructing oil passages, which may shut off the supply of lubricant to rocker arms, timing gears, and even bearings.

PARTS WILL BREAK

Every kind of a machine is subject to broken parts, which may fail occasionally. In the case of an engine, items that may break and affect the lubrication system are the relief valve spring, oil lines or pump drive. Each of these will interrupt oil flow to parts that require lubrication.

On engines that have 30 to 40 thousand miles of service it is possible that the oil pump has worn enough to lower the oil pressure. Two types of oil pumps are common in engines today—the gear-type pump, and the rotor type.

The gear pump makes use of two spur gears, one driven by the pump shaft and the other one an idler gear, driven by the shaft driven gear. The operating principle is very simple: There is a very small clearance between the ends of the gears and the recess into which each one fits—.002" to .003". Thus a pocket is formed between each two adjacent gear teeth. A seal is provided at the point where the two gears mesh, with a very small clearance between the meshing teeth. As the gears rotate, oil fills the pockets between the gear teeth, and as each pocket gets around to the meshing point of the teeth, the oil is squeezed out under pressure and flows out through an oil passage located at this point.

The gear pumps used on car engines will easily maintain a pressure of 40 to 100 psi. Some more precisely made pumps can maintain pressures of 300 to 500 psi or even higher. Another application of this type of pump is to furnish the pressure for operating power steering equipment.

Wear on the gear pump usually takes place between the ends of the gears and the housing or pump cover. In some cases the housing can be filed down flat, on the surface against which the cover fits. The cover plate,

(Continued on page 32)

"So you want to open a service shop?"

It's like leaving home to "go on your own" the first time. Here's "boot training" for the ex-salaried-employe embarking on the tossing seas of independent enterprise.

Part III—Laying Out the Shop.

By HERB CARRIER, Detroit Editor
and
DR. GEORGE A. FIELD, Wayne State University

• REGARDLESS OF THE KIND of shop you intend opening, one phase of setting up includes your acting the part of a "tailor." Each square foot of the building you rent, lease, buy or build has to be carefully analyzed so that it can deliver maximum return per dollar invested.

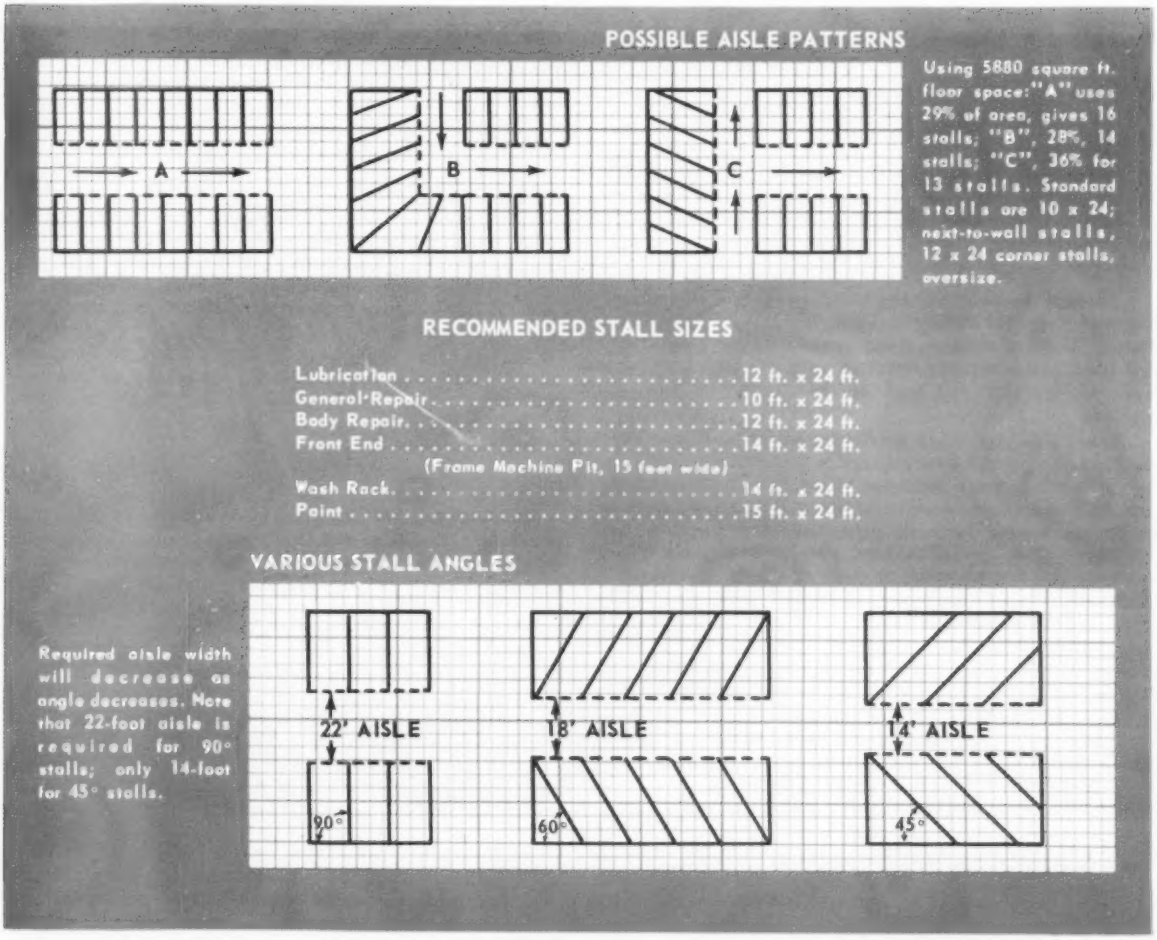
Some fixtures, those to be permanently placed, require special planning. Small items, like work benches, can be tried in several different areas; but such others as hoists and front end machines are usually placed to stay. You must be certain permanent-type fixtures are placed in the best possible locations.

SCALE MODEL HELPFUL

One of the better ways to plan space utilizations is to use a scale model. This need not be elaborate. Graph paper and cardboard cutouts work very well, and require no artistic or mechanical drawing ability.

To use graph paper, let one inch of paper (about 20 lines) represent one foot. Then scale-out your actual floor area. Leave enough additional space so that you can include your parking lot plan, if your business will need one. Also mark clearly the windows, doors, electrical outlets, exhaust outlets, stairways, lavatories, etc. If the ceiling is one height throughout the building, make a notation on the side of the page. If there are high and

Don't fight the detail of that point in planning when you actually "work-over" available floor feet and build the shop in miniature. Though it may be tedious, it can prove the short cut to success.


POSSIBLE AISLE PATTERNS
A
B
C
Using 5880 square ft. floor space: "A" uses 29% of area, gives 16 stalls; "B", 28%, 14 stalls; "C", 36% for 13 stalls. Standard stalls are 10 x 24; next-to-wall stalls, 12 x 24 corner stalls, oversize.
RECOMMENDED STALL SIZES
Lubrication . . . . . 12 ft. x 24 ft.
General Repair . . . . . 10 ft. x 24 ft.
Body Repair . . . . . 12 ft. x 24 ft.
Front End . . . . . 14 ft. x 24 ft.
(Frame Machine Pit, 15 feet wide)
Wash Rack . . . . . 14 ft. x 24 ft.
Paint . . . . . 15 ft. x 24 ft.
VARIOUS STALL ANGLES
Required aisle width will decrease as angle decreases. Note that 22-foot aisle is required for 90° stalls; only 14-foot for 45° stalls.
22' AISLE
18' AISLE
14' AISLE
90°
60°
45°

low ceiling areas, mark the low spots on the floor plan using a dotted outline. You can also shade the low ceiling areas with pencil to make them stand out. Ceiling height is very important for hoist location. Show natural obstructions, such as posts and columns, in their proper size and location on the graph paper.

STALL LAYOUT AND AISLES

Use the cut-out method for figuring stall layout. General repair stall size is 10′x24′, body work stalls are 15′x24′, and truck stalls vary in size according to the size of the truck. In general, the work activity determines the size of stall in relation to the size of the vehicle.

The width of the service area varies with stall layout. A garage with service stalls laid out at 90° to the aisle, should have an aisle 22′ wide. A layout of stalls 45° to the aisle requires an aisle width of 14′.

Continuing the cut-out method, experiment with stall layout using the alphabet soup approach. This means, of course, that layouts fall into letter-patterns, P-shape, L-, I-, T-, U- and O-shapes, are most common.

In any pattern, be sure to figure on mechanic's work area of about 5′ to 7′ in front of each stall. It's also a good idea to keep an eye to your source of natural light. Stalls facing windows are most practical from this standpoint.

STALL LOCATIONS

In planning a layout, don't fail to capitalize on your proposed equipment. Purposely locate impressive front-end machines, tune-up equipment, and electrical diagnosing equipment near the customer reception area. These items have considerable "self-sell"—don't hide them in the back corner!

Front End—This is best near the front of the shop where it can be easily seen and approached. Front end alignment machines require a straight drive-on angle, so adequate jockeying space is necessary.

Light Repair—These stalls also belong near the front of the shop. This is where customers will be acting as "over-the-shoulder" superintendents. Don't fight to keep customers out of the shop. Remember your shop will be serving car owners on a man-to-man basis. Your customers will want to see what goes on in the business end of your garage. Encourage them to do so, but keep them in the most pleasant and interesting sections—the tune-up, light repair, electrical, front end areas.

Lubrication—Here is another focal point for customers. When a car goes up in the air, it seems to draw customers as moths are drawn to a light bulb. This is good. Underneath the car you have them in an ideal selling position. Locate your lube racks where they'll attract customers, and where cars can easily enter and leave without disrupting the whole shop. A separate entrance is valuable for a lube rack.

Heavy Repair—A "back corner" area. For one thing, traffic turn-over is slow. Another important point: it

(Continued on following page)

Opening A Shop? . . . CONTINUED

gives the appearance of someone having major troubles and huge repair bills. No car owner likes to think of these possibilities.

Wash Rack—Drainage, water supply, and accessibility are determining factors here. Investigate carefully to determine whether a wash rack would be good business for you. Usually, a single rack doesn't pay its way in dollars and cents; but it is a good customer traffic builder.

Storage Areas—Cleaning solvents, alcohol, and painting materials, all require special handling and storage. Before locating storage areas permanently, check local fire laws, and insurance requirements. Be sure you cope with all the vital red tape *before* any actual work is started.

Along this line, it's a good idea to not only meet all zoning laws, but to save yourself a lot of embarrassment by presenting your business plans to the local civic groups. Some home owner organizations are strong enough to change zoning laws, or prosecute your business for nuisance value. By telling local people about the kind of business you are planning to open up *in their neighborhood*, you can get clearance and contact prospective customers at the same time.

The importance of meeting all rules and regulations cannot be overemphasized. Be absolutely certain your type of business will be acceptable in the area where you plan to operate. Don't assume that because a repair shop was operating in the building you intend to occupy, it will be all right to open up a collision shop, or even a welding shop. Local safety ordinances may prohibit it.

One sure-fire method of checking out shop stall layout, shop lighting, and special wiring needs is to pay a few visits to shops in your area that are in operation. A short, friendly conversation with the owner or working mechanic will soon reveal good and bad points about various layouts. It will also help you to firm up, or toss out, some of your doubtful ideas.

PLAN THE FUTURE

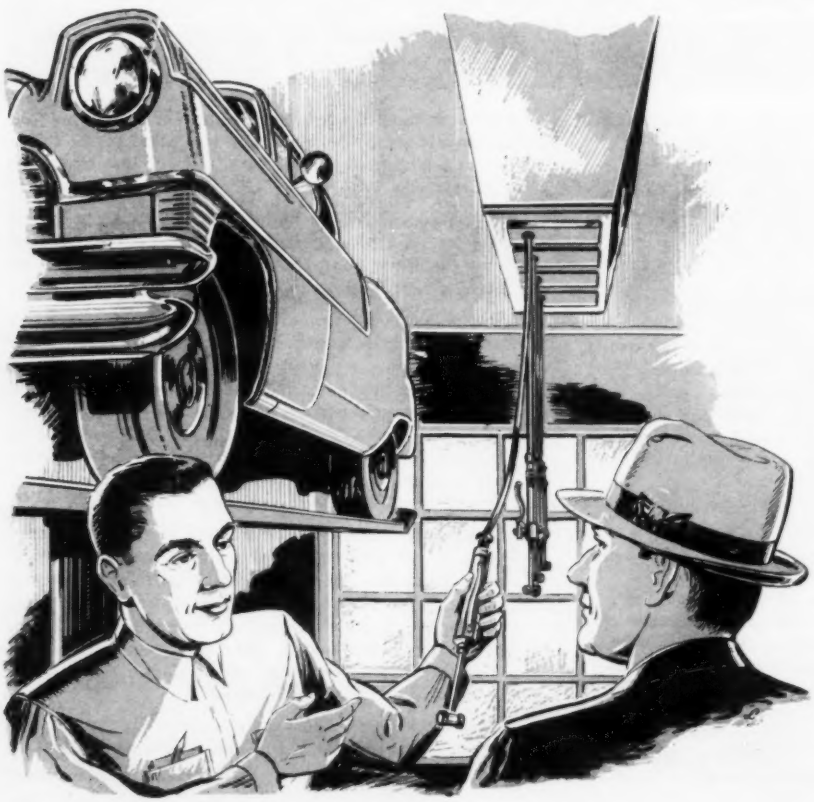
Whenever possible, plan for likely future expansion. Think about extra hoists, for example, that you might want to install some day. It's not necessary to reserve a stall for this purpose; but locate permanent fixtures so that if additional equipment is needed, it can be put in without extensive revamping.

This eye-to-the-future planning also carries over into heating, plumbing, and lighting, especially if you are building a garage. A comparatively slight extra cash outlay at the beginning may save thousands of dollars later on, if you are forced to expand.

LIGHTING

It's amazing the difference good lighting can make to a garage. Like it or not, the general public looks upon service shops as dark and dirty places—which too often they are. Yet with proper lighting it's possible to have not only a brighter shop, but a cleaner one. According to commercial lighting authorities, workmen have a definite habit of keeping things clean in a well lighted work area. Tests prove much better housekeeping is practiced when there are no dark corners to throw things into.

Customers, too, prefer to deal with well lighted places of business. A dimly lit shop doesn't indicate a profitable, successful business. In most cases, increasing illumination where necessary, will result in a cleaner, neater, more prosperous-appearing establishment.



Lube stalls get a real play in customer interest. Use the fact to sell "extras" that the customer needs, and the shop provides at a fair profit.

The public and local businessmen who'll be neighbors can be helpful in many ways. By explaining your plans, you can often win clearances, if needed, while contacting prospects.

Your local utility company will be very willing to help you plan adequate lighting for your garage. They will also discuss your entire electrical needs, and offer much valuable information.

Most utility companies have men in their employ whose sole job is to work with customers. In one sitting, these men can point out electrical uses and abuses that might not occur to an average garage owner. This valuable (and free) service should be used whenever possible.

In rural areas it may not be practical to call on the utility company; even in large cities, it may be too inconvenient and time-consuming. When this is the case, an electrical contractor can be your source of information. Be sure he understands your present problem and your future possibilities, so that he can make intelligent recommendations.

APPEARANCE MAKES A DIFFERENCE

In starting a new business, appearance is very important. Look first at the overall building. Does it need painting? Quite likely it will. This can be a do-it-yourself project, if you are operating on a tight budget. However, don't try to cut too many corners on the paint itself. Select good quality, and spend some time preparing the surface to be painted. Good paint on a properly prepared surface will stand up for several years. Cheap paint, or even good paint on a poor surface, will quickly need replacing.

For the building exterior, select a color that goes well with the surrounding area, yet is attractive enough to win some attention.

Inside the shop, make good use of color. Paint the ceiling and the top two-thirds of the walls white for its reflective quality. Consider green for the lower third of the walls. Strike a bright yellow band all around the shop as a separator between the green and the white.

Use the same yellow to paint a four inch stall marking line, and to paint a traffic flow arrow on the floor.

Fire and safety equipment should be mounted on a red background. The same red is a good color for the work benches, front end machine, floor jacks, stands, etc.

DRAINAGE AND EXHAUST CONTROL

Proper drainage and an adequate exhaust control system are vital considerations in any shop.

An open type of floor drain with standard grating and trough is one of the most effective and easily maintained systems. In modernizing older shops, it might be well to consider installing a trough-type drain, especially in climates where there's lots of snow in the winter. With the trough drain, cars can be quickly washed free of snow before they are placed in a stall. This is a big help in keeping the work areas dry and clean.

An efficient system for removing exhaust gases is required by most city ordinances covering garages. In areas where exhaust systems aren't mandatory, they should still be installed for the sake of health and safety. It's possible to buy complete systems as "package" units. Either overhead or floor system can work well if correctly installed. When checking out older systems, make sure the ducts are free from obstructions, and the blowers in good shape.

By starting business with a clean, well lighted, properly laid out building, your chances of success are greatly improved. If you plan your shop with an eye to the future, and comply with all zoning and insurance regulations, you have avoided mistakes that limit the potential of some businesses and cause others to fail.

Low Oil Pressure . . .

(Continued from page 27)

if worn by the ends of the gears, can be filed and then made perfectly flat by rubbing on abrasive cloth laid on the flat bed of a drill press or on a piece of plate glass. It can also be made flat by rubbing on a piece of plate glass on which water-mixed valve grinding compound has been spread. If the gear teeth are worn a new pump is required.

On most of the Chrysler-built cars and on some of the Ford engines the pump using the inner and outer rotor, is supplied. The principle of operation is the same as the pump using two spur gears; that is, trapping oil in spaces between the lobes and squeezing it out as the rotor turns.

Obviously, the oil level in the oil pan should be watched and maintained at the proper point. If this level is allowed to drop too much the oil pressure will drop and a damaged engine may result. Never forget that engine lubricating oil is the "life blood" of the engine, and without a sufficient amount the engine cannot function very long. It's a good point to emphasize with customers.

CONTAIN CORROSIVE ACIDS

Dirty oil will not lower the oil level unless sludge forms and the oil pump screen becomes clogged. However, dirty oil may contain corrosive acids, abrasive carbon or abrasive dust. For this reason recommend to customers to change the oil at the recommended intervals. The filter should be changed at every second or at the most, third oil change. The air cleaner must also be serviced frequently and extreme care taken to see that there are no leaks in the air passage to the carburetor through which dust can enter. Dirt in most cases is very abrasive and if it gets into an engine can greatly shorten the life of rings, cylinder walls, and bearings.

Oil leaks can allow a surprising amount of oil to escape. Leaks should be spotted and corrected if and when they occur. The oil pan, the rocker arm cover, the head gasket, front and rear seals on the crankshaft, may allow oil to leak out, and these points should be watched. On engine overhaul jobs, be sure that recommended specs are adhered to in assembling the engine parts to avoid oil leaks.

The subject of oil pressure drop is not as simple as it might seem at first thought. Therefore, the points we have covered should be given consideration. Attention of car owners should be called to the importance of maintain-

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ing the correct oil level, changing oil filters frequently, correcting oil leaks promptly, servicing the air filters, and having the engine serviced or overhauled when oil pressure drops from worn engine parts, or noise and loss of power indicate the need for service work.

Improperly Gapped Plugs Will Cause Early Failure

"Why do spark plugs fail after a few hundred miles?" is a question frequently asked by both car owners and shopmen. According to the Electric Auto-Lite Co., the answer is usually found in the comparative values of the available and required voltages—the available voltage being that which is delivered to the spark plug terminal . . . the required voltage being that which is needed to produce a spark at the spark plug electrodes.

The most common factors affecting available voltage are poor insulation or slight gaps in the high tension wiring and connections or high resistance in the primary circuit. Of course, the coil and contact condition as well as the cap and rotor also affect the available voltage.

Required voltage is lowest when the electrodes have sharp corners. After a short usage the corners begin to round off so the spark plug operates at the lowest voltage for only a short time.

If the available voltage is only slightly higher than the required voltage when new spark plugs are installed, there is no indication of future trouble as the plugs and engine operate normally. As the corners of the electrodes become rounded the required voltage gradually rises. When this required voltage becomes higher than the voltage being delivered to the spark plugs, the engine falters.

The same effect can be obtained with an ignition system in good condition by increasing the voltage required by the plug. Besides the rounding of the electrodes, the two main factors which increase this required voltage are the size of the electrode gap and the amount of deposits on the insulator tip. These fouling deposits do not actually increase the required voltage but bleed off some of the available voltage so that more secondary voltage must be produced to "fire" the plug.

In nearly all of the early failure cases the cause is a marginal ignition system or failure to properly gap the plugs.

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Automotive Service Digest

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Trouble shooting the starting system

There is nothing mysterious or unusually difficult about this work when mechanics follow a given line of procedure, acquire the necessary knowledge, and understand the specific instructions supplied by the various makers of test equipment.

By GUY F. WETZEL
Technical Editor

• THE STARTING SYSTEM consists of the cranking motor, the starting switch, cables and wires, and the device for engaging and disengaging the cranking motor pinion with the ring gear on the flywheel. Starting involves four operations: (1) engaging the starting pinion with the flywheel ring gear, (2) completing the starting motor electrical circuit, (3) breaking the circuit, and (4) disengaging the starting motor from the flywheel ring gear. The exact sequence in which these operations are done will vary somewhat depending on the driving device and the switch arrangement used.

BUILT AS SINGLE UNIT

The starting motor and the device for energizing and for engaging and disengaging the pinion and flywheel ring gear, are built and installed as one unit. However, for understanding and also for servicing them, they will be considered as separate units.

Cranking motors used on passenger cars have four field poles. Some have two shoes with field windings and two without. Those without windings are merely to complete the magnetic circuit. Some of the later type motors have three shoes with series winding and one with a shunt winding. This is to give better speed characteristics. There are four brushes to supply ample current carrying capacity. Two brushes are insulated and two are grounded. Starting motors turn out a surprising amount of power for their size, developing from one to three horse power, depending on the size of the engine and the conditions when

Fig. 1—When replacing an armature, be sure to refer to the parts book for the car and model number, and the proper part number.

the engine is being cranked. The current required to produce the necessary torque for turning the engine over is 125 to 300 amperes for summer starting and 300 to 700 amperes for winter starting, with 6 volt systems. Where the voltage is 12, the current will be about half as many amperes.

PARTS CARRY HEAVY CURRENT

To carry these heavy currents the cables between the battery, the switch, and the motor must have ample current carrying capacity, and the connections at each point must be clean and tight. The windings, commutator and brushes must be larger than those of generators because the starting current will be 10 to 15 times as great as the current put out by the generator. The commutator and brushes must have low resistance at the points of contact. The brushes are approximately 96% copper, which makes the brush seating process somewhat different from that used for carbon brushes.

In cases where the cranking motor has seen several years of service, the commutator will be become worn. Sometimes it is worn eccentric, and/or the surface becomes pitted and rough. Quite often, the motor stops at the same position each time after cranking the engine. This means that sparking and heavy initial current flow take place at the same spots on the commutator frequently, which tends to roughen or oxidize these areas. When this proceeds far enough, the joint between the brushes and commutator no longer conducts current and the cranking motor will not operate.

TURNING THE COMMUTATOR

When this happens, the armature must be removed and have the commutator turned. This can be done in an engine lathe, using a steel jaw chuck to drive the shaft and a bronze jaw chuck to act as a bearing for the other end. However, a small special purpose lathe designed for this job can be used more conveniently.

It is recommended that the starting motor commutator be undercut 1/64" and no more, after which the motor should be assembled and run free for several short periods. The burrs from the undercutting will quickly seat the brushes much better than it can be done with the methods usually applied to generators. After the brushes are seated to about 90% of their contact surface, sand the commutator with 00 sandpaper to remove the remaining burrs. By limiting the undercutting to 1/64" the grooves will be shallow and will not have a tendency to fill up with metal particles that might cause a shorted commutator. Undercutting should always be .002" wider than the thickness of the mica between the

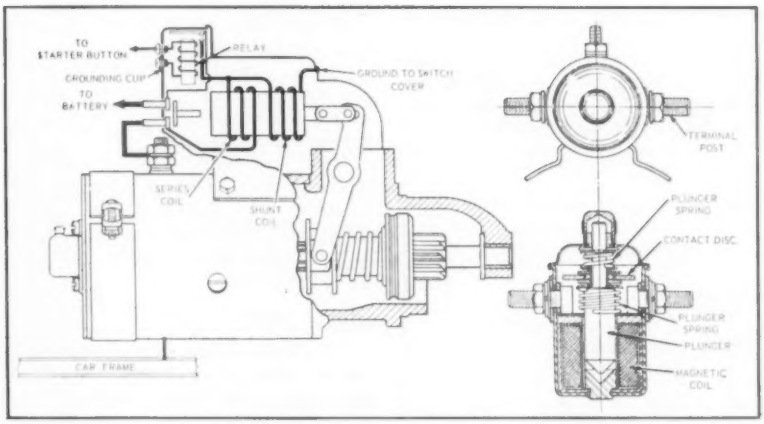

Fig. 3—Wiring connections for solenoid cranking motor control on over-running clutch. Closing relay circuit gives solenoid power to move pinion shift lever. Near end of stroke, plunger operates motor starting switch. Typical Bendix solenoid switch (right), closes motor switch only.

segments. The maximum run-out on commutators should not exceed .003".

The armature on a cranking motor seldom burns out as may happen to a generator armature. However, there may be grounds, or opens, or shorts. To test an armature, the growler is used in the same way as on generator armatures. The armature is rotated in the jaws of the growler and a piece of hack-saw blade or feeler stock (.010" or more thick) is held parallel to the armature slots, with growler current turned on. If there are any shorts in the windings, the steel blade will be attracted and vibrate at the location of the shorted winding.

Opens and grounds are checked with the test light. In some cases, shorts or grounds can be located by putting a low voltage heavy current through a test circuit, so that the grounded or shorted spot will be shown up by heating and probable sparking. This can often be reinsulated which will save the armature.

The field windings are subject to occasional grounds. These are checked with the test light, by touching one prod to the motor frame and the other to the end of the field winding, being sure that neither of the grounded brushes is touching any grounded metal.

Bearings on starting motors are generally plain sleeve bearings of bronze, bronze graphite, absorbent or porous bronze. Where the porous bronze bearings are used it is necessary to lubricate the motor. Where there are oilers, a few drops of oil should be added every 3000 to 5000 miles.

STARTING SWITCHES

All the later model cars use relay starting switches, with relay controlled by the ignition switch starting contact, by the accelerator pedal, or by a push button switch. The relay current energizes a solenoid which closes the starting motor circuit, and this in turn energizes the motor. The location and particular type of motor switch depends on the kind of motor drive used, but the principle is the same in each case.

A fairly powerful solenoid winding, when energized, pulls in a magnetic plunger which closes a heavy duty switch. This switch completes the starting motor circuit and allows the required heavy current to flow through the motor. With all cranking motors except those equipped with the Bendix drive, this solenoid also causes the motor drive pinion to be engaged with the flywheel ring gear.

Thus it will be seen that there are two circuits in the starting system, (1) the relay circuit, which only carries a current of a few amperes, and (2) the motor-battery circuit of high amperage. Trouble in either circuit can keep the system from operating.

MOTOR DRIVES

The cranking motor armature must revolve at a fairly high speed to produce a strong cranking effort. To accomplish this, the cranking motor is fitted with a small drive pinion which meshes with the teeth on the flywheel ring gear. The gear ratio, ring gear to pinion is around 16 to 1, or even higher, which permits the motor to develop a relatively high

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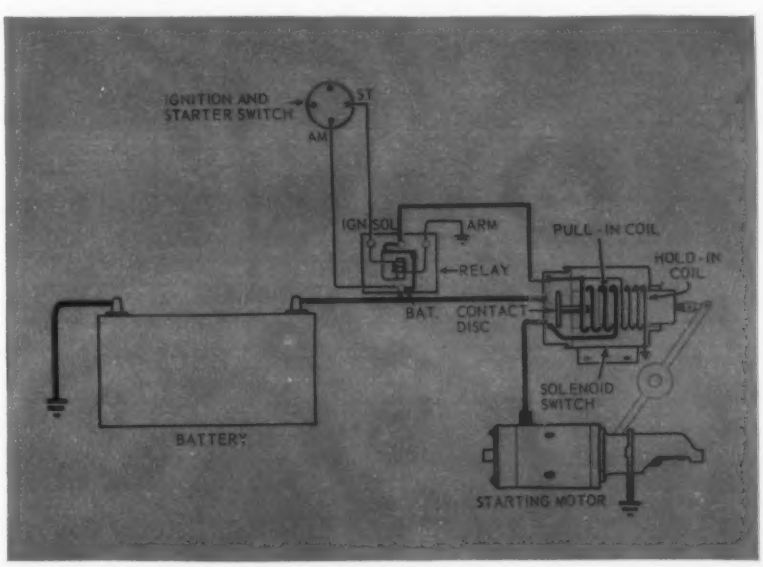


Fig. 2—Wiring of starting system, showing the relay and gear shifting solenoid switch circuits. (*Illustration courtesy Auto-Lite*)

armature speed and considerable power while cranking the engine at a comparatively low speed.

After the engine starts, its speed immediately increases and it may soon reach a speed of 3000 rpm or more. If, as frequently happens, the car operator "steps on the gas", engine speeds may run even higher. If the motor drive pinion should remain meshed with the flywheel ring gear, the motor armature would spin at speeds up to 48,000 rpm or higher, with the 16 to 1 gear ratio. This excessive speed would quickly ruin the armature, so to prevent this, several different devices are used which will mesh the pinion with the flywheel for cranking, but will cause the motor pinion to get out of mesh as soon as the engine is started.

There are three types of cranking motor drives which accomplish the meshing and demeshing of the starter pinion, (1) the Bendix drive, (2) the over-running clutch drive, and (3) the Dyer drive.

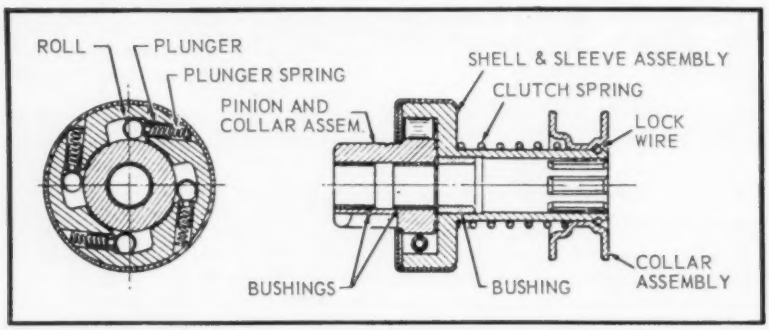
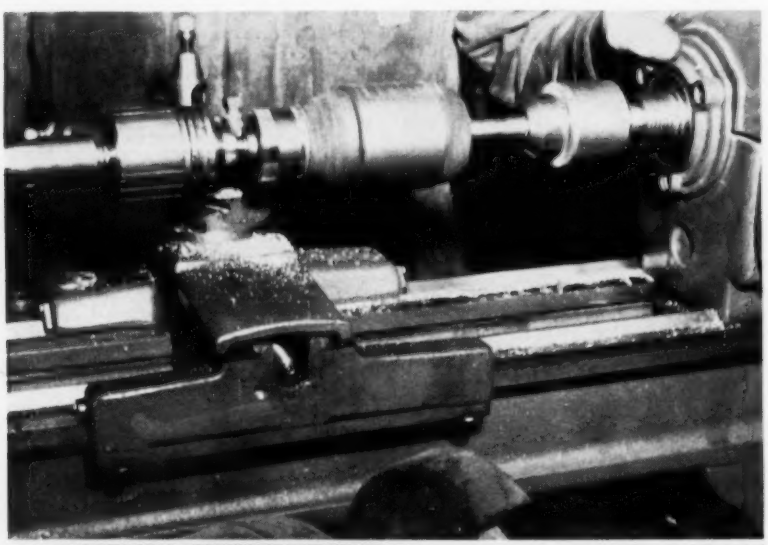
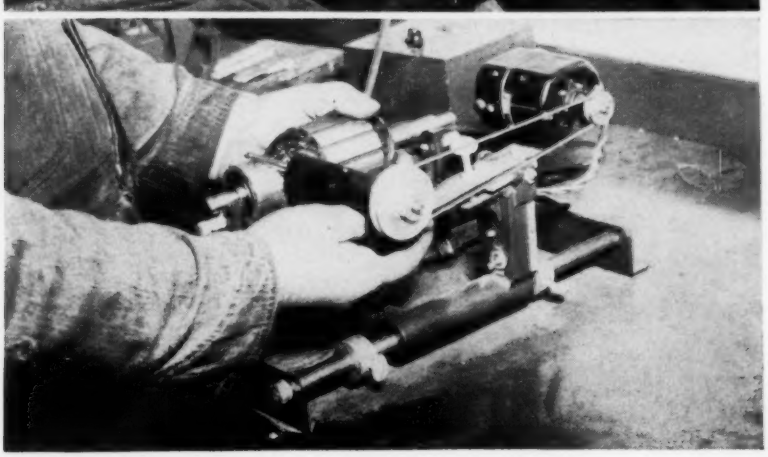


Fig. 4 (above) — Detail of the over-running clutch, which allows the starting motor to drive the flywheel but does not permit the flywheel to drive motor shaft.

Fig. 5 (below)—Turning a starter commutator shaft on an engine lathe. A three-jaw chuck drives the armature shaft, and bronze jaw chuck is used on tail stock end.





BENDIX DRIVE

The Bendix Drive provides an automatic means of engaging the drive pinion with the engine flywheel ring gear, for cranking the engine and for disengaging the drive pinion from the ring gear after the engine starts.

The drive pinion is mounted on a threaded sleeve or hollow shaft which has spiral threads that match internal threads in the drive pinion. The sleeve is a loose fit on the cranking motor shaft. One end of the sleeve is bolted to the Bendix Drive spring and the other end is keyed and bolted to the armature shaft drive head.

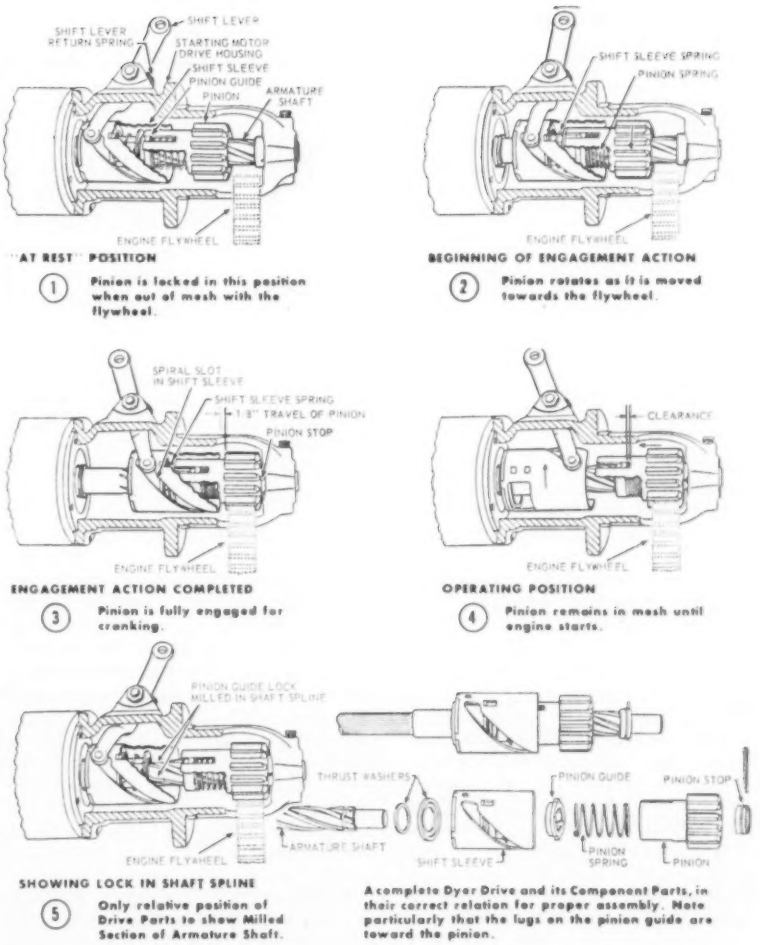
When the cranking motor is not operating the pinion is in a position so that it will not mesh with the flywheel ring gear. As soon as the cranking motor switch is closed the armature begins to rotate, picking up speed very rapidly. The threaded drive sleeve picks up speed with equal rapidity since it is driven by the drive spring. However, the pinion which is a loose fit on the sleeve does not pick up rotative speed quite as fast as the armature. The result is that the threaded sleeve turns within the pinion forcing the pinion endwise along the shaft and into mesh with the teeth on the ring gear. This action is somewhat similar to holding a nut stationary and turning a screw in it so that the nut would move along the length of the screw. As the drive pinion reaches the pinion stop on the end of the sleeve it can move outward no further and must then rotate with the sleeve and the armature, driven by the spring to cushion the shock of engagement of the pinion and the torque of the cranking motor.

As soon as the engine starts, the flywheel ring gear spins the drive pinion more rapidly than the armature is rotating with the result that the pinion is backed out of mesh and away from the ring gear.

The Bendix drive ordinarily functions well, but the trouble shooter

Fig. 6—Whenever starting motor commutator is turned down, it should be undercut, as shown here. This machine does good job.

Fig. 7—Operating stages of the Dyer drive, which is used on a number of cars in the General Motors line.


SHIFT LEVER
SHIFT LEVER RETURN SPRING
STARTING MOTOR DRIVE HOUSING
SHIFT SLEEVE
PINION GUIDE
PINION
ARMATURE SHAFT
ENGINE FLYWHEEL
"AT REST" POSITION
1 Pinion is locked in this position when out of mesh with the flywheel.
SHIFT SLEEVE SPRING
PINION SPRING
ENGINE FLYWHEEL
BEGINNING OF ENGAGEMENT ACTION
2 Pinion rotates as it is moved towards the flywheel.
SPIRAL SLOT IN SHIFT SLEEVE
SHIFT SLEEVE SPRING
1.8" TRAVEL OF PINION
PINION STOP
ENGINE FLYWHEEL
ENGAGEMENT ACTION COMPLETED
3 Pinion is fully engaged for cranking.
CLEARANCE
ENGINE FLYWHEEL
OPERATING POSITION
4 Pinion remains in mesh until engine starts.
PINION GUIDE LOCK MILLED IN SHAFT SPLINE
THRUST WASHERS
PINION GUIDE
PINION STOP
ENGINE FLYWHEEL
ARMATURE SHAFT
SHIFT SLEEVE
PINION SPRING
PINION
SHOWING LOCK IN SHAFT SPLINE
5 Only relative position of Drive Parts to show Milled Section of Armature Shaft.
A complete Dyer Drive and its Component Parts, in their correct relation for proper assembly. Note particularly that the lugs on the pinion guide are toward the pinion.

should know what to look for if it does not work as it should. Trouble will be indicated if the cranking motor spins when the circuit is closed but the engine does not revolve. This will be due either to the pinion sticking on the threaded sleeve and not sliding outward to engage the ring gear, or to a broken spring or broken spring stud, or screw.

The threaded sleeve should never be oiled because the oil will pick up dirt and form a sticky gum on the threads, preventing the pinion from moving outward as it should. The spring and screws seldom break. If they do, their replacement is quite simple. Ford products generally use the Bendix Drive.

OVER-RUNNING CLUTCH DRIVE

The over-running clutch type of cranking motor drive is designed to provide positive meshing and demeshing of the drive pinion and ring gear. This drive uses a shift lever which slides the clutch and drive pinion assembly along the armature shaft so that the pinion can mesh with the ring gear. The clutch transmits torque from the cranking motor armature to the engine flywheel but permits the drive pinion to over-run or run faster than the armature after the engine is started. In other words, the pinion can drive the flywheel, but the flywheel cannot drive the pinion. This protects the motor armature from being driven at excessive speed during the brief period that the pinion remains in mesh with the flywheel ring gear, or in case the pinion is not quickly demeshed from the ring gear.

In this drive, on all the later model cars which use it — most of the Chrysler cars and some of the General Motors cars—a powerful solenoid is energized by the closing of the relay circuit by the car operator, and the solenoid first moves a lever which engages the motor pinion with the ring gear. Then by a little additional movement, it closes the heavy duty switch which energizes the motor circuit.

With this there are several different kinds of trouble that may arise. If the relay circuit has high resistance or an open circuit, the solenoid will not operate. If the splined shaft on which the clutch and pinion slide should become gummy with oil or rough with rust, the solenoid may not have power enough to move the pinion into meshing position. If the switch contacts which close the motor circuit should become burned or corroded and do not make a sufficiently good contact, the motor will not start even though the gears may be in mesh.

In one case that was called to our attention, the starter would work intermittently. After careful checking it was discovered that the pivot pin on which the shifting lever worked had partially worked its way out of position and sometimes would allow the pinion to shift and at other times would stick and not move the pinion. Replacing the pin cured the trouble.

DYER DRIVE

The Dyer Drive is only used on some of the General Motors cars. It is a type of drive mechanism which provides for positive engagement of the cranking motor drive pinion with the flywheel ring gear before the cranking motor circuit is closed and the armature begins to rotate. As soon as the engine starts, the pinion is automatically demeshed by the reversal of torque so the armature will not be damaged by excessive speed. This works somewhat on the principle of the Bendix Drive for disengaging the motor pinion and ring gear, though the engaging is done in a manner similar to that used on the over-running clutch drive.

On the Dyer Drive, as in the case of the other two, all parts must work freely, both to engage and to disengage the pinion. Anything that will interfere with the free working of the parts will keep the pinion either from engaging or disengaging. The relay circuit must be in good working order, and the motor circuit contacts must be clean.

In case the flywheel ring gear should be damaged or worn from long use and have to be replaced, care must be taken that the right ring gear is used. Ring gears for use with the Dyer Drive have the ends of the gear teeth beveled just opposite to the bevel used for the Bendix Drive, so that these types are not interchangeable.

On the over-running clutch drive and the Dyer Drive, it will be noted that the solenoid which operates the

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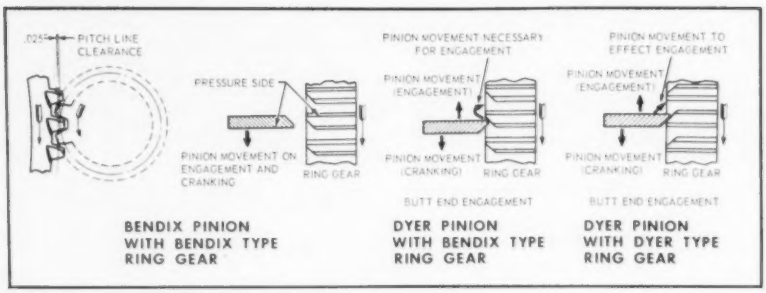


Fig. 8—Detail of flywheel ring gear and pinion teeth, reveals the difference between those of the Dyer and Bendix drives.

pinion shift, also operates the motor circuit switch; so that these units may be subjected to either electrical or mechanical troubles, if trouble arises, it must be identified and corrected. In general, if the trouble is electrical, nothing will happen when the relay circuit is closed; while if it is mechanical, the motor will spin without engaging the drive pinion with the flywheel ring gear.

On the Bendix Drive, the solenoid operated motor switch is generally located close to the starting motor, and all this unit does is to close the motor circuit. With this drive, there is no doubt about whether the trouble is electrical or mechanical.

If the starter does not operate at any time when the device used to close the relay circuit is operated, a logical procedure should be followed to locate the cause of the trouble. This will be based on a knowledge of how the system works and the wiring and parts involved.

ELIMINATE RELAY CIRCUIT FIRST

The first step is to eliminate the relay circuit. This is readily done by jumping from the battery side of the motor circuit to the relay contact at the solenoid housing. If the starting motor operates, it indicates that either the relay switch is defective or there is a loose connection or other "open" in the circuit. Correcting this will put the system back in operation. If this test does not locate the trouble, next check the battery to be sure it is at least 50% charged, though it should have a gravity of at least 1.250 corrected for electrolyte temperature.

If the battery is all right, then check all connections for voltage drop with the starting switch closed. Be sure battery, motor switch connections, motor connections and ground strap connections are clean and tight.

With the battery and connections

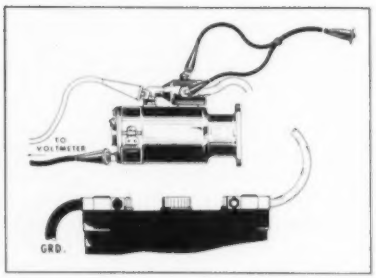


Fig. 11—Connect voltmeter as shown to measure battery voltage drop when starting motor operates. Excessive voltage drop is an indication that battery charge is low, battery bad, or starting motor defective.

eliminated, see if the solenoid which engages the motor pinion operates when the starting switch in the relay circuit is closed. This can be heard if it operates: and if it does but the motor does not, it would indicate that the motor switch inside the solenoid and lever housing is defective, on the Dyer Drive or the over-running clutch drive, or that the motor itself is defective. In either case, removal of the cranking motor and its attached solenoid and switch housing is required.

On the bench, the motor can be checked by running a cable direct to the motor side of the motor switch from a battery, with the housing grounded to the other side of the battery, by-passing the switch. If the motor operates, the trouble is in the solenoid or switch, and the whole unit (not the motor) should be replaced.

If the motor, directly connected to a battery does not operate, it will

Fig. 9—Starting motor armature should be tested for shorts. Hold a steel blade parallel to the armature slots; shorted coils will draw the blade to the slot, where it will vibrate as a further indication.

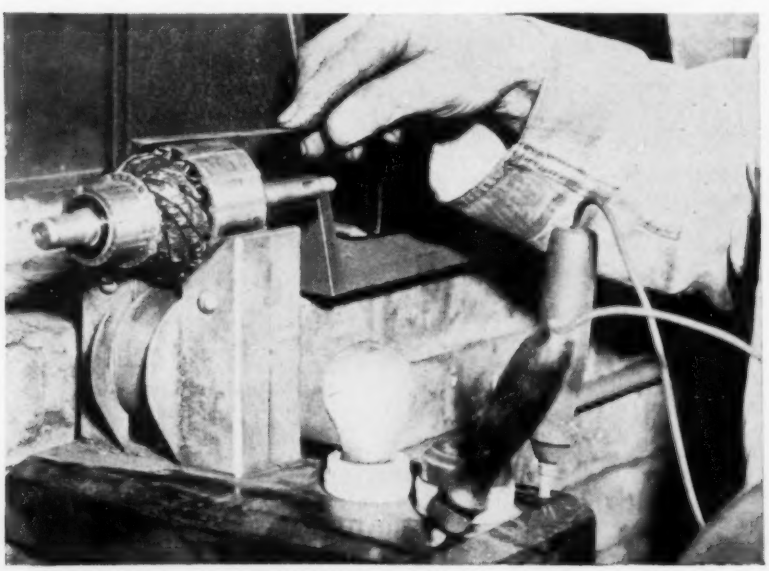
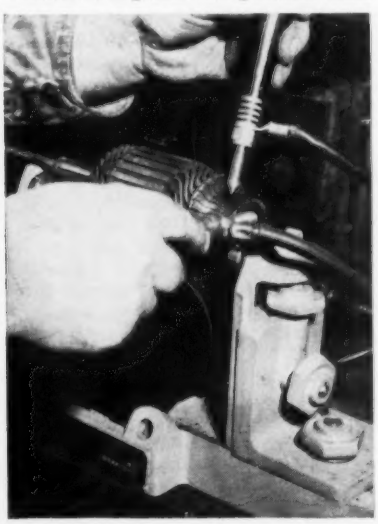


Fig. 10—Heavy prods connected across a battery will indicate grounding through heating and sparking when touched to the commutator segments and grounded shaft.



STARTING SYSTEM TROUBLES

SYMPTOM	CAUSE	REMEDY
Starter does not operate	1. Discharged battery	1. Charge battery
	2. Open relay circuit	2. Correct "open"
	3. Defective relay switch	3. Replace
	4. High resistance in relay circuit	4. Locate and correct
	5. Defective motor circuit switch	5. Repair or replace
	6. Poor circuit contacts	6. Clean and tighten
	7. Dirty commutator	7. Sand or turn
	8. Worn motor brushes	8. Replace brushes
	9. Opens, grounds, or shorts in motor	9. Repair or replace
	10. Excessively worn motor bearings	10. Replace bearings
	11. Neutral safety switch not in neutral position	11. Relocate in correct position
	12. Defective Neutral safety switch	12. Replace switch
Starter motor spins but does not start engine	1. Bendix Drive spring or screws broken	1. Replace parts
	2. Bendix pinion stuck on thread	2. Loosen pinion or replace drive
Starter pinion engages but motor does not operate	1. On Dyer or over-running clutch drive, motor circuit contacts do not make good contact.	1. Clean contacts, or replace control unit
Motor runs too slow to start engine readily	1. High resistance in motor circuit	1. Clean and tighten contacts
	2. Poor contacts in motor switch	2. Clean contacts or replace control unit
Poor ground through generator (on some engines)	1. Loose contacts or break in conductor	1. Clean and tighten contacts, or replace conductor
Pinion jams against ring gear teeth	1. Worn tooth ends on ring gear	1. Replace ring gear, and possibly pinion

have to be taken apart to check both its mechanical condition and electrical condition.

Occasionally there will be complaints that the starter jams. This is caused by the motor pinion jamming against the end of a tooth on the flywheel ring gear. It will not happen unless the teeth on the ring gear have been worn flat or burred from poor engagement of the pinion. If it does happen the only way the engine can be started is to get the jammed gears disengaged. With the conventional transmission, this can be done by putting the transmission in high and rocking the car backwards. With automatic transmissions about all that can be done is to loosen the starter hold-down bolts, or remove it, and disengage the gears. To prevent recurrence of this trouble a new ring gear should be pressed on the flywheel, and a new pinion if needed. Be sure the correct ring gear is used, if a new one is installed.

On cars with automatic transmissions, there is a neutral safety switch in the relay circuit. This switch opens the relay circuit when the transmission control lever is in any position other than "N" (neutral) or on some cars "P" (park). In some cases this switch will shift its position and will not close the relay circuit with the lever in "N" position, but will operate in some other position. Once in a while, the switch itself is defective and will not close the circuit in any position. This must be kept in mind as a possible source of trouble is in the system.

Improper Tire Preparation Main Cause of Tubeless Tire Patch Failures

When patches fail on tubeless tires, it is usually not the fault of the patch, but the fault of the person doing the job . . . and in nine out of ten cases, the mistake made is the improper preparation of the tire to receive the patch.

So cautions B. S. Byall, sales manager for the Dill Mfg. Co., Cleveland, Ohio, who points out that this conclusion was arrived at from a recent survey conducted by the company.

According to Mr. Byall, the inside of every tire contains mold lubricant, particularly silicone, and every trace of the lubricant must be completely scraped away before buffing, to prevent working the lubricant into the tire lining and gumming up the buffing tool brush.

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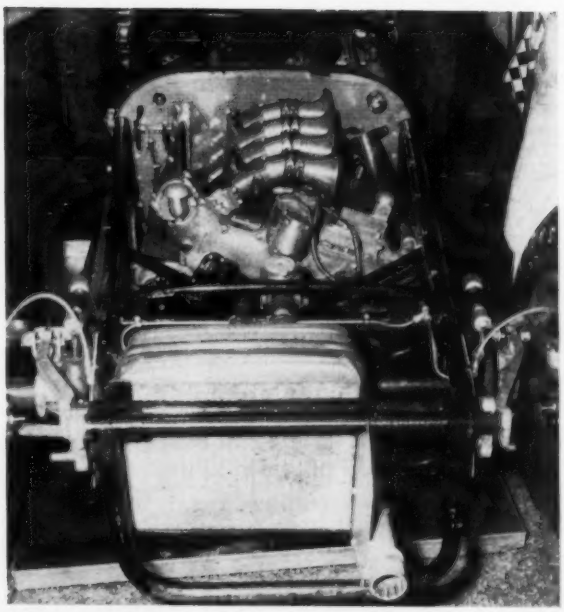
Jimmy Bryan in the Belond A-P Special which he piloted to victory at a speed of 133.791 m.p.h. Incidentally, this is the same car in which Sam Hanks set a new track record in 1957.

BRYAN WINS "500"

HOW THEY FINISHED

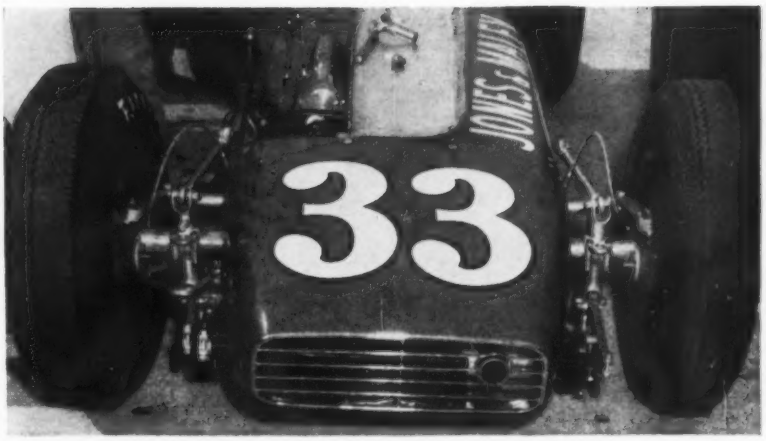
CAR	DRIVER	M.P.H.
1. Belond A-P Spl.	Jimmy Bryan	133.791
2. Demler Special	George Amick	133.517
3. Bowes Seal Fast Spl.	Johnny Boyd	133.099
4. Jones & Maley Spl.	Tony Bettenhausen	132.855
5. Leader Card 500 Spl.	Jim Rathmann	132.847
6. John Zink Spl.	Jimmy Reece	132.443
7. Bob Estes Spl.	Don Freeland	132.403
8. John Zink Spl.	Jud Larson	130.550
9. Bryant Heating Spl.	Eddie Johnson	130.156
10. Novi Auto. Air Cond. Spl.	Bill Cheesbourg	129.149

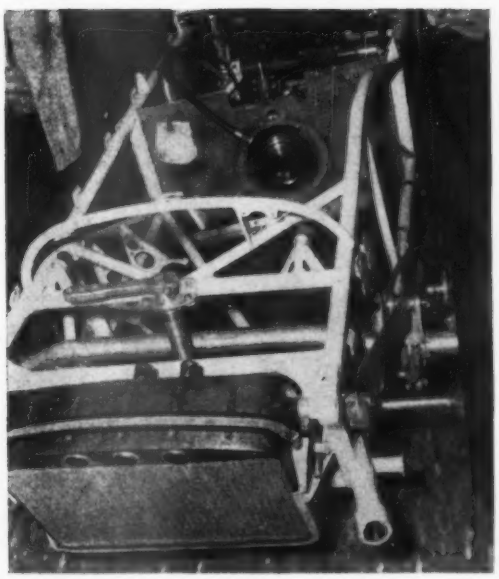
The famous supercharged Novi engine. This year two plugs were used per cylinder, along with a new magneto setup.

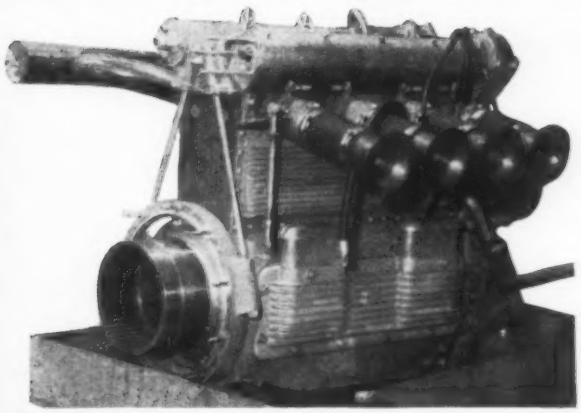


View of the 4-cylinder, 261 cu.in. Meyer-Drake engine which powered Jimmy Bryan to victory. It is mounted five inches to the left of the center of the car and is lying on its right side at an 18° angle from horizontal, centering its weight on the left side of the car.

The Jones & Maley Special, driven by Tony Bettenhausen to fourth place at a speed of 132.855 m.p.h. The car is 25" high at rear of hood, 36" high at head rest and tread is 52". Redesigned engine is installed at 15° position.



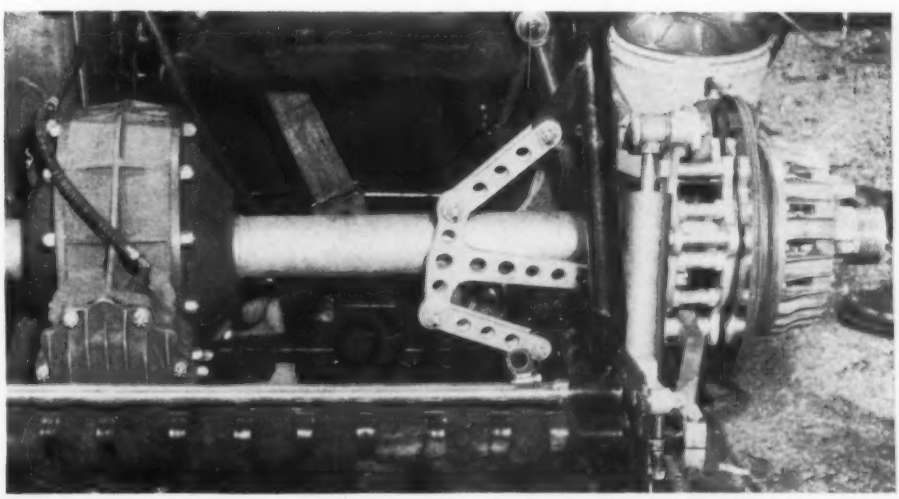


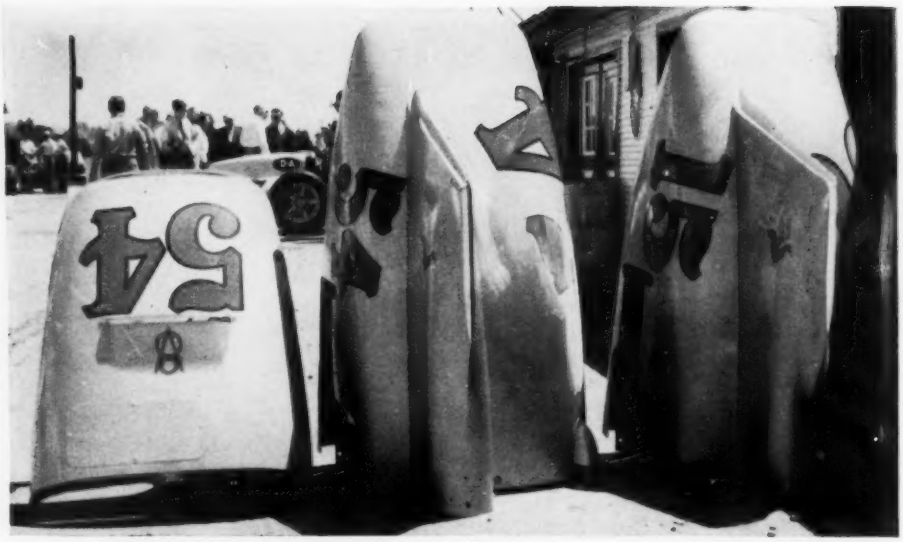


The formidable 4-cylinder Offy—this one out of the Dean Van Lines Special.

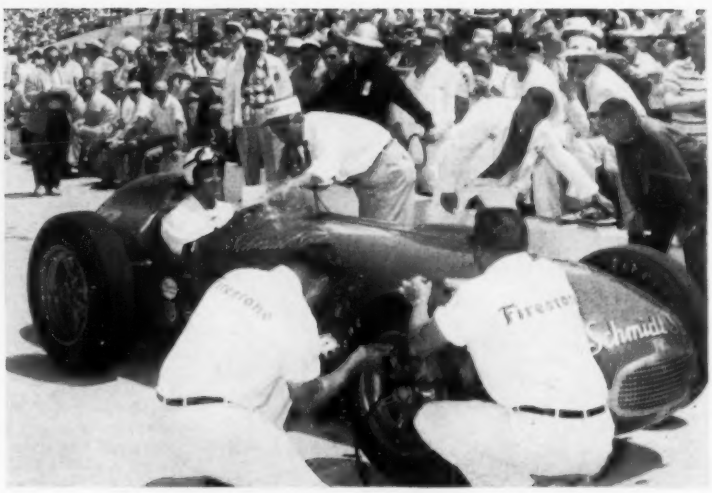
Frame of the No. 8 Wolcott Special, showing steering set up and manner in which engine is set to right of driver, upright at a diagonal. At time picture was taken, engine had been removed to permit frame straightening, after car hit wall during practice run.

Quick-change rear end, disc brakes and shock absorber setup as used on many of the Indianapolis cars. This particular car uses an anti-sway damper.

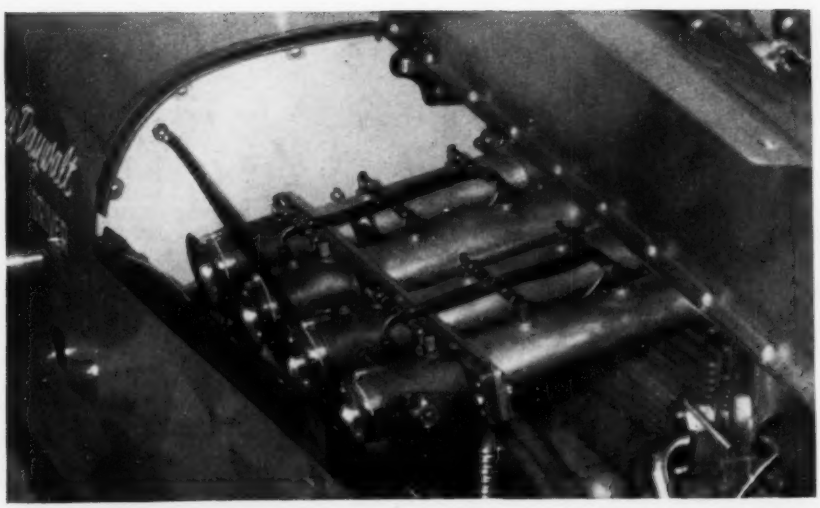




No, these are not nose cones from a "Sputnik," but the noses, tail and body shell from the Novis.



After cars make qualifying run, Firestone experts check all tires to make sure all is well. Here they go over the Schmidt Special driven by Eddie Sachs.



A look at the special fuel injection and tuned exhaust stacks of the Helse Special. This car was wrecked during time trials, was rebuilt in two days and nights and qualified by Art Bisch.

This year cars were moved around by small garden tractors to eliminate the need for pushing or driving them.

Every wheel and tire used in the race is checked and double-checked for balance.

Transmission Drain-Refill Periods Subject to Type of Service Involved

According to a recent service bulletin from the Chrysler Corp., the drain and refill period under average operating conditions for their automatic transmissions has been established at a 20,000 mile interval.

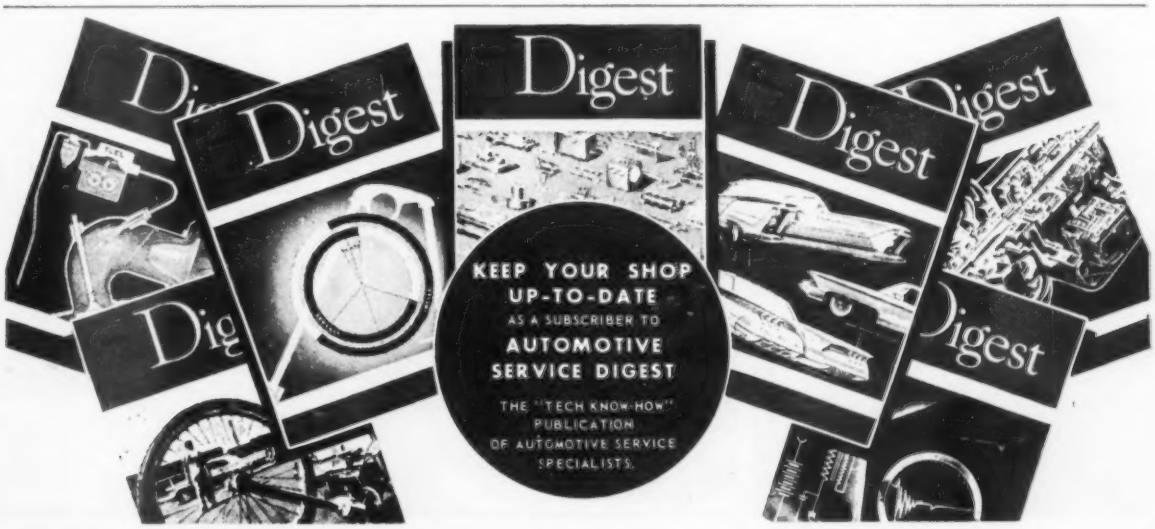
However, certain types of service subject the fluids to more severe operating conditions, so the factory now recommends that the change interval for transmissions subjected to the following types of driving be reduced to 10,000 miles: police car or turnpike patrol cars; frequent towing of trailers; frequent heavy traffic operation in hot weather; airport transportation; continuous operation at higher than normal loading, as well as continuous operation in mountainous areas.

The factory also warns that cars equipped with automatic transmissions should not be idled in gear for long periods, as high transmission temperatures can develop, resulting in sludge, deterioration of lubricant, and eventual transmission failure.

Increasing Valve Lash Improves Torque and Idle Characteristics

Torque and idle characteristics can be improved on Plymouth's 1957, 277, 301 and 318 cu.in. engines and '58. 318 cu.in. engines by increasing the intake valve clearance from .008″ to .010″ at hot idle. According to company engineers, this change will also provide less valve face and valve seat wear.

The exhaust valve clearance remains unchanged at .018″ at hot idle.



Air Conditioning . . . *(Continued from page 14)*

takes place in any make of air conditioner.

The illustration of a simplified refrigeration system includes the following basic parts: compressor; condenser; receiver; expansion valve and evaporator. Using Freon-12 as our refrigerant, here's what takes place.

The Freon-12 gas under low pressure is drawn into the compressor, where it is compressed. During the compression the Freon-12 gas becomes heated, and when sufficient pressure is built up, the hot Freon gas passes into the condenser. Here it cools by giving off heat to the air passing over the condenser surfaces.

In cooling, this hot Freon gas condenses into a liquid at high pressure, and accumulates in the receiver. From the receiver, the high pressure liquid Freon flows to the expansion valve at the inlet side of the evaporator, then through the evaporator or cooling coils under a much lower pressure.

When the Freon is exposed to the lower pressure, it begins to boil and changes to a vapor state. As the Freon passes through the evaporator, boiling continues due to the absorption of heat from the air passing over the evaporator surfaces until it is completely vaporized.

As seen in the illustration, the evaporator outlet connection leads to the compressor which draws the cool, low-pressure Freon back into the compressor to repeat the cycle.

The entire cooling action in any car air conditioner results from air passing over the evaporator surfaces and being cooled simply by giving up heat to the refrigerant liquid during the boiling process

Service fundamentals are all that it takes to keep a car air conditioner operating satisfactorily, but let's take the principal parts of the system one at a time.

Compressor: Driving this requires nothing but a V belt (or belts) properly adjusted. Mechanically, many compressors employ parts similar to the pistons, rings, bearings, etc. of an engine.

Condenser: This unit, much like a radiator, and mounted in front of the car radiator, needs to be kept free of bugs, dust and dirt, the same as the outside of a car radiator would be kept clean.

Receiver: This is nothing but a high-pressure storage tank. No special problem.

Expansion valve: Details on servicing this will be given in later articles. Many mechanics solve the problem by replacement.

Evaporator: From the service standpoint this unit is more or less like a car heater. Its effectiveness is dependent upon the temperature of the coils (cold, however, instead of hot) and the flow of air across them. This air flow is dependent upon a motor-driven fan (or fans) very much like the fan (or fans) of a car heater. So again we have nothing too astonishing to worry about.

Testing both the high and low pressure sides of the car air conditioner employs gauges basically the same as a compression gauge (high pressure side) and a vacuum gauge as commonly used for adjusting carburetors (low pressure side).

Servicing the lines requires the ability to make good double flared connections, with tightening done with tubing wrenches to avoid distortion.

Of course the gauges referred to are not engine com-

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WHAT'S THE MATTER, BOB?
MY GIRL'S MAD AT ME. SAYS I'LL NEVER GET ANYWHERE BECAUSE I'M NOT A GOOD ENOUGH SALESMAN. GEE, GIRLS ARE FICKLE!
YOU CAN LEARN SALESMANSHIP!
I KEEP FORGETTING WHAT THE BOSS TELLS ME TO SAY! WHEN A CUSTOMER COMES IN THERE'S SO MUCH TO DO, I JUST PLAIN FORGET SALESMANSHIP!
GOSH! MAYBE SHE NEEDS NEW FRONT WHEEL OIL SEALS!
WELL, IT'S ALL DONE. IT WAS A WORN OIL SEAL... BEARING GREASE WAS GETTING PAST THE SEAL ONTO THE LINING... CAUSING IT TO SLIP. I'LL SHOW YOU THE OLD SEAL.
ALL RIGHT!
SEE, MA'AM, HOW THIS FRONT WHEEL INSTALLATION TOOL FROM CHICAGO RAWHIDE SHOWS WHERE THE SEALS ARE WORN. I REPLACED THEM IN A JIFFY WITH CHICAGO RAWHIDE SEALS THAT I KEEP HERE IN STOCK.
YOU'VE SOLD ME— EVEN IF I DON'T UNDERSTAND ALL OF IT!

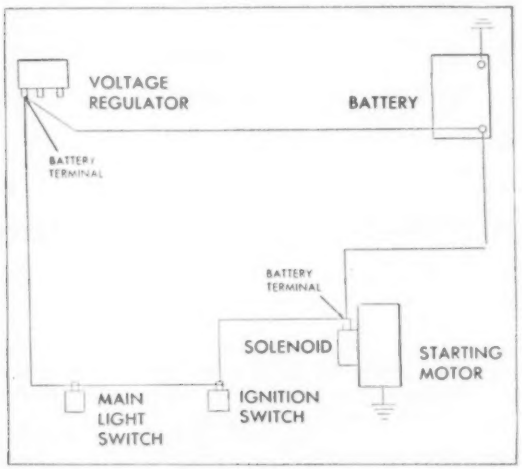
pression gauges or conventional vacuum gauges, though the internal mechanisms are similar.

Proper tools and equipment as well as certain key supplies are required for the servicing of air conditioning systems. These and the established test procedures, will be presented in a forthcoming article.

Removal of Battery Ground Strap Protects Chevrolet's Electrical System

The precaution of removing the battery ground strap before working on any electrical system components is of extreme importance on 1957-58 Chevrolet vehicles. According to a factory service bulletin, this step is emphasized because the "loop" circuit wiring harness on these vehicles permits battery current to enter the starter solenoid terminal from either the battery cable or from the ignition switch, even with the ignition switch in the "off" position.

Accidental grounding in any part of the circuit may burn out the wiring in the harness or damage some electrical component.



Chevrolet's 1957-58 "Loop" Circuit Wiring

Idle Adjustment Procedure

Experienced mechanics are pretty well agreed on the steps required to get a good idle adjustment. The starting point is an engine that is thoroughly warmed so that the carburetor and all components will be at normal operating temperature. Then with the help of a tachometer the idle speed is adjusted to specifications—commonly in the neighborhood of 425 r.p.m.—for the Golden Hawk, 550 r.p.m.

The idle mixture valve (or valves) are now adjusted. To begin with, each valve is turned to the right, leaning the mixture until there is just the very *slightest loss of engine* r.p.m.

Then one valve at a time is opened up (turned counter-clockwise) enriching the mixture to the point where the r.p.m. shows its greatest increase. For smoothness and economy the valves are both turned alike to the right, and only so far as they can be turned *without reducing engine speed.*

Finally, since the engine has speeded up due to the better idle mixture, the throttle screw is once more adjusted so that engine's r.p.m.'s agree with specifications.

WELL, HERE'S SOMETHING TO HELP YOU REMEMBER TO ALWAYS CHECK FOR WORN, LEAKY OIL SEALS. I'LL HANG IT HERE WHERE YOU CAN'T MISS IT.
GEE! COMIC STRIPS ARE MY FAVORITE!
THIS STRIP ISN'T COMIC. IT REMINDS YOU OF THE EXTRA BUSINESS OBTAINED FROM REPLACING WORN FRONT WHEEL OIL SEALS WITH C/R OIL SEALS. YOU'LL BE DOING YOUR CUSTOMERS A SERVICE AND BRING IN MORE SALES AT THE SAME TIME.
EXCUSE ME. HERE COMES A CUSTOMER.
HELLO, BOB. I'VE GOT CAR TROUBLE. EVERY TIME I STOP IT PULLS TO THE LEFT. I THINK YOU'D BETTER CHECK THE BRAKES WHILE I GO SHOPPING
MA'AM, IT'LL BE A PLEASURE. I'LL DO IT RIGHT NOW.
YOU'RE A REAL SALESMAN, BOB. YOUR GIRL WILL BE PROUD OF YOU, NOW!
GIRL? WITH ALL THIS EXTRA BUSINESS I CAN GET ANY GIRL! SHE'S TOO FICKLE!
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Automatic transmissions

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BY HERB CARRIER
Detroit Editor

Part VIII—Servicing the Powermatic

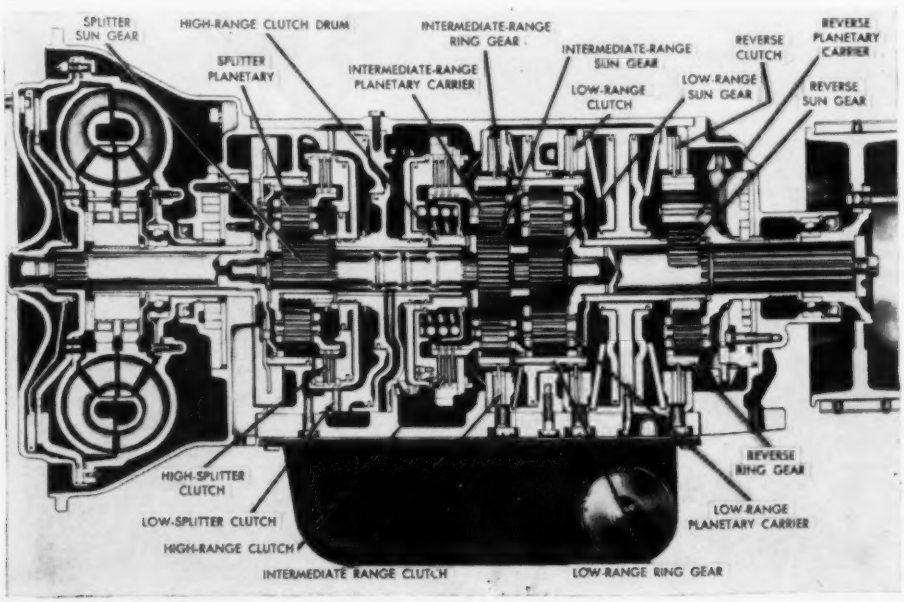
• ONCE THOUGHT OF as luxury gadgets for high priced passenger cars, the automatic transmission has become a highly respected option for heavy-duty trucks. The big three—Ford, Chevrolet, and Chrysler, plus a goodly number of independent truck producers, have accepted the automatic transmission as part of their truck package. And, strangely enough, most are using the same basic transmission—that made by the Allison Division of General Motors Corp.

On Chevrolet trucks the unit is called *Powermatic*. Ford calls it *Transmatic*. With Dodge, it becomes *Torqmatic*. The independents, too, have coined various names for their units.

Unit for unit, *they're all identical*; the only differences being in the individual design of the control linkages to meet design requirements of the different makes and models of truck cab and chassis units.

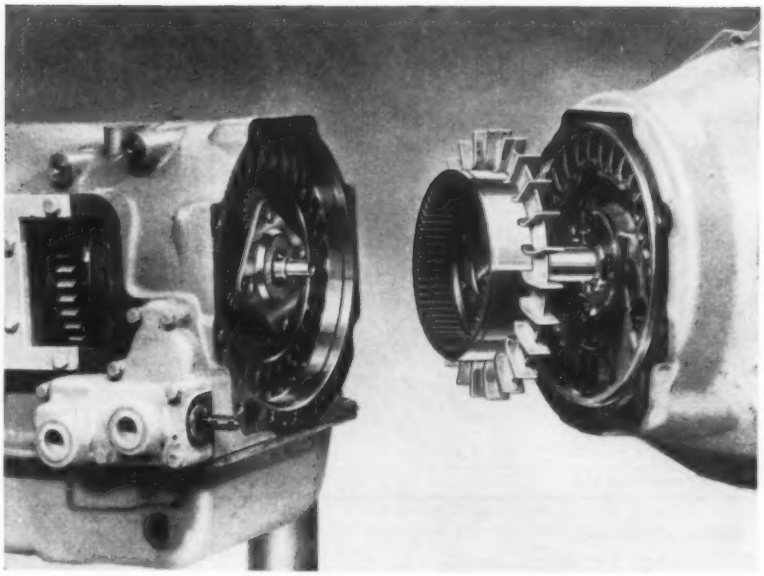
CONSTRUCTION FEATURES

Powermatic (we'll use this name for the sake of simplicity) consists of a two-stator torque converter, a transmission with four planetary gear sets, and complete hydraulic and mechanical control systems. In addition, Powermatic has a lockup clutch device built into the torque converter to provide a direct mechanical connection between the engine and the transmission, a self-contained hydraulic retarder to take part of the load from the service brakes on long down grades, and the Powermatic uses no bands or servos. In their place, disc



Cross section view of the Powermatic Transmission.

(Illustrations courtesy Ford Motor Company)



The hydraulic retarder consists of a vaned rotor connected to the transmission output shaft, and a cavity between the converter and transmission. There are fixed vanes around the outside edge of the cavity. For retarder action, the driver presses the cab-mounted pedal which opens a valve and admits transmission oil into the retarder cavity. The rotor churns the oil against the fixed valves, which causes considerable drag on the rotor, causing the vehicle to slow down. When driver releases pedal pressure, fluid quickly drains from cavity.

clutches are used to position the transmission in its various gear ratios.

DELIVERS SIX FORWARD SPEEDS

The transmission is designed to deliver six forward speeds, neutral and reverse. The selector lever can be placed in Low (Lo), Intermediate (Int), Drive (Dr), Neutral (N), or Reverse (R). In Low the transmission operates in first and second speeds. In Intermediate it operates in third and fourth speeds. In Drive the transmission can be operated in third, fourth, fifth, and sixth gear.

Some late model quadrants are marked 1-2, 3-4, 3-5, 3-6, plus N and R. In this case, the numbers indicate the gear ratios. For example, in the 3-5 position the transmission will operate in the third, fourth, and fifth gear.

LOCKUP OPERATION

In any torque converter, the pump operates faster than the turbine at all speeds below the coupling point. In the Powermatic transmission, a lockup clutch plate is splined to the converter turbine hub and rotates at the same speed as the converter turbine. At lockup speed—just past the coupling point—the clutch piston forces the clutch plate against the reaction plate. The result is a solid mechanical connection between the engine and the transmission gears.

The clutch is automatically disengaged when the transmission gears are shifted, either manually or automatically.

HYDRAULIC RETARDER

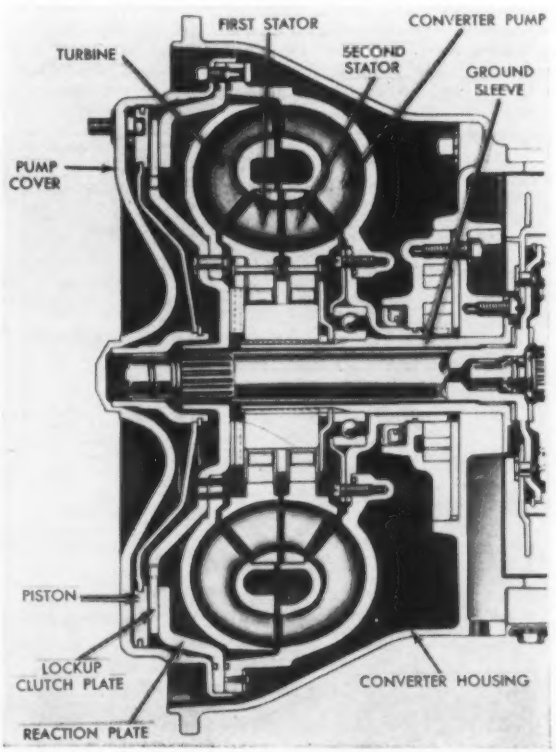
A vaned rotor, located in a cavity between the transmission and the torque converter, is the main mechanical component of the hydraulic retarder. The rotor is attached to the transmission output shaft.

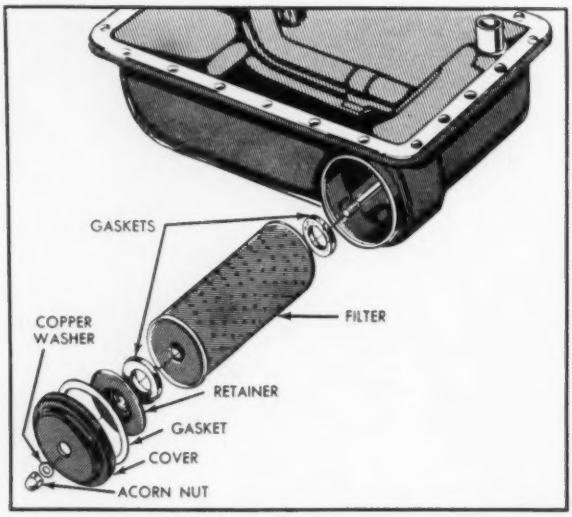
Fixed vanes are cast on the outer edges of the cavity on either side of the rotor. In operation, oil is pumped into the cavity by the transmission pumps. The rotor churns the oil against the fixed stators. The violently churning oil exerts pressure against the spinning rotor tending to retard its motion. Because the rotor is solidly connected to the transmission output shaft, any slowdown of the rotor results in a slowdown of the vehicle's drive shaft, and finally of the vehicle itself.

A floor-mounted pedal allows the driver to admit or drain fluid from the retarder cavity in controlled amounts.

(Continued on following page)

Torque converter has the usual pump and turbine, but it also has two stators, and a lockup clutch assembly. At speeds slightly faster than the coupling point, the lockup clutch automatically engages to cause a mechanical connection between the engine and transmission. The clutch is disengaged each time an automatic upshift or downshift is being made.





Powermatic-type transmissions have a built-in oil filter which should be changed on a regular mileage or monthly basis. Under normal use, 10,000 miles or three months is recommended. In dusty areas, 5,000 miles or three months constitutes a change period. Always use new gaskets and copper washer when installing a new filter, and carefully torque acorn nut to 8-10 ft. lb.

Automatic Transmissions . . . CONTINUED

It's not necessary for the driver to completely fill the cavity for maximum braking unless he wants to. If only minimum retarder action is desired, the driver merely exerts minimum pedal pressure.

GEAR COMBINATIONS AND RATIOS

The four planetary gear sets are mounted in series, and in line with the torque converter output shaft. The first gear set is the splitter planetary. Next comes the intermediate planetary, the low planetary, and, finally, the reverse planetary.

The splitter planetary works with any one of the other planetaries to split or divide the three basic ratios to obtain six forward speeds and reverse.

First: In first gear the splitter system is in Low (1.39 to 1). The low range clutch holds the low range ring gear stationary. This results in a first gear ratio of 5.296 to 1. At stall, the converter is capable of multiplying this by 2.8.

Second: In second gear, the splitter system is in High (1 to 1). The low gear planetary system operates in the same manner as it does in first gear. Because the splitter system went from low to high, the second gear ratio, with converter in lockup, is 3.81 to 1.

Third: In third gear, the splitter goes back to Low (1.39 to 1) with the splitter output shaft turning the intermediate range sun gear clockwise. With converter in lockup, the resultant third gear ratio is 2.691 to 1. With the converter at stall, an additional torque ratio of 2.8 is available.

Fourth, Fifth, and **Sixth:** The shift pattern follows itself out through the remaining gear ratios in an identical manner. As the unit shifts gears, the splitter first goes into low range, then into high range. This is how it is possible for Powermatic to get six complete forward speeds.

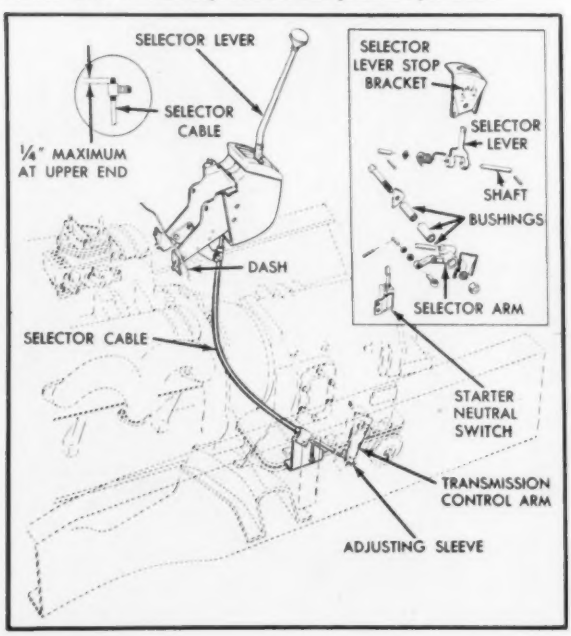
Reverse: In this range, the splitter system is in Low, and the reverse ring gear is held stationary by the reverse range clutch. The reverse range gear ratio is 6.042 to 1, with the converter in lockup. At converter stall, an additional 2.8 torque ratio is available.

Neutral: The splitter system is in the 1.39 to 1 (Low) range during neutral. No motion is delivered to the vehicle's drive shaft because none of the range clutches are applied. However, the power take-off drive gear is in operation in neutral.

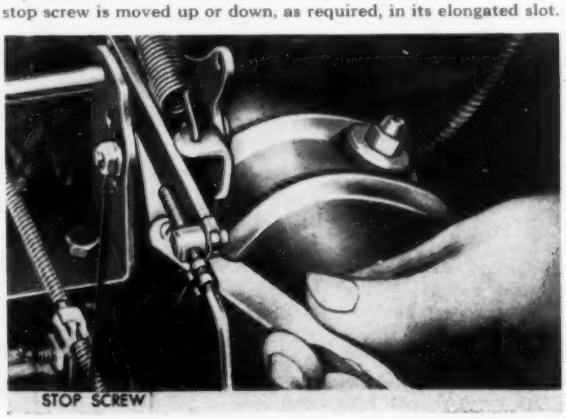
IN-VEHICLE SERVICE

Powermatic has its own oil filter located in the transmission oil pan. To replace a filter, remove the acorn nut

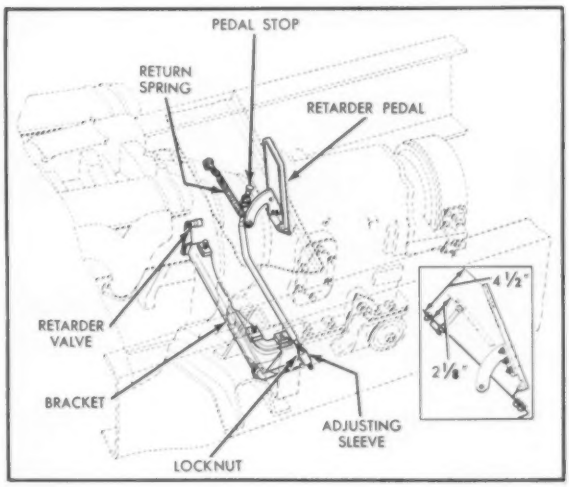
The selector lever is connected to the transmission control arm by a cable. A sleeve at the transmission end of the cable is mounted on a threaded section of the cable. By disconnecting the sleeve from the lever, placing both selector lever and transmission lever in the R (reverse) position, and then adjusting the sleeve so it slips freely into the hole in the lever, the selector lever can be adjusted for all quadrant positions.



A .020" feeler gauge is used to check clearance between the bellcrank and the stop screw, when making throttle linkage adjustment. If this clearance is not within specifications, the stop screw is moved up or down, as required, in its elongated slot.



Retarder pedal adjustment includes adjusting pedal height, pedal stop height and length of retarder control rod. Pedal and pedal stop adjustments are simple mechanical operations. The retarder control rod adjustment depends on the sound the retarder valve makes when it bottoms in its casting. With pedal against its stop, and retarder valve bottomed, the rod length is adjusted so the sleeve pin slips freely into the lever hole. Then the rod is lengthened to provide 1/8" clearance between pedal and stop at full retarder application.



and washer; then remove cover, gasket and old filter. When installing a new filter, use a new gasket and acorn nut washer (copper). Tighten nut to 8-10 ft.lb.

If oil filter is unusually dirty, it's a good idea to remove the oil pan for cleaning. Thoroughly wash the pan with cleaning solvent and air dry. Use a new pan gasket, and new pickup tube seal rings when installing the oil pan. Tighten pan bolts to 8-10 ft.lb.

IDLE ADJUSTMENT

Naturally, this specification might vary according to make of vehicle, but generally trucks equipped with this type of automatic transmission should have an idle speed of 475-500 r.p.m.

To adjust idle, set the hand brake, and place the transmission in neutral. Connect a tachometer, and start the engine, allowing it to reach normal operating temperature. If unit is equipped with a carburetor that uses an automatic choke, make sure the carburetor linkage is *off* the fast idle cam when the engine is completely warmed up. Then adjust the throttle stop screw and the idle mixture adjusting screws to obtain a smooth, steady idle at 475-500 r.p.m.

Some engines respond best when a vacuum gauge is used to adjust the idle. In this case, adjust the carburetor to the highest steady vacuum at recommended idle speed.

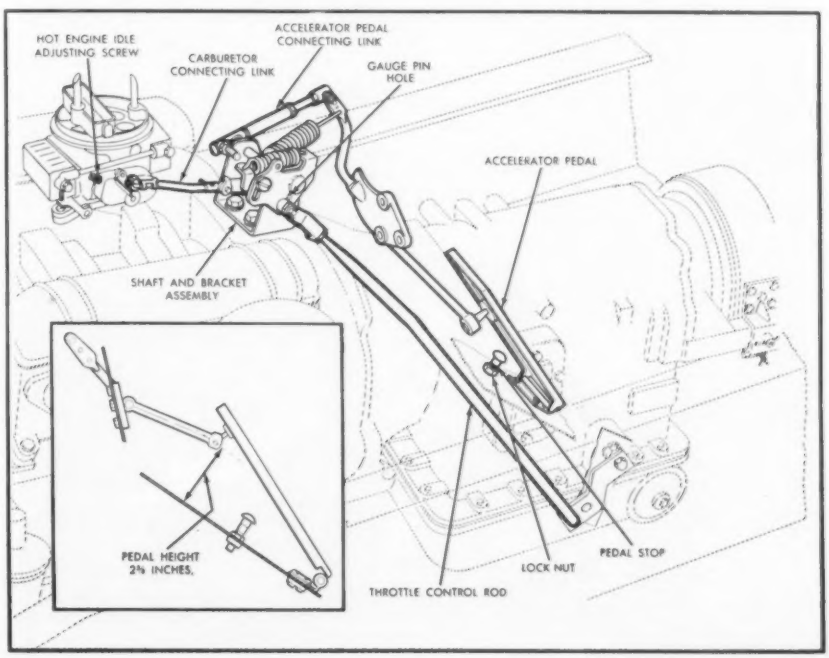
LINKAGE ADJUSTMENT

Again, these adjustments are pertinent to only one make of truck. In this case, a Ford truck with Transmatic transmission.

Selector Lever: To check the selector lever linkage adjustment, disconnect the control cable at the transmission lever. Place the lever in R (reverse); also place the transmission lever in the reverse detent. In this position, the sleeve pin should freely enter the hole in the transmission lever. If adjustment is necessary, run the sleeve up or down the threads until it lines up with the lever hole. Securely connect the sleeve to the lever, and check selector lever operation in all quadrant positions.

Starter Neutral Switch: Check to see if cranking motor can be operated in any other position besides neutral (N). If it can, loosen the bolts that fasten the switch to the shift bracket. Relocate the switch until the cranking motor will operate only when the selector lever is in neutral (N). Then securely tighten the switch mounting bolts. Recheck operation to make sure the switch didn't shift during the tightening operation.

(Continued on page 78)



Throttle linkage runs from accelerator pedal to shaft and bracket assembly. From here, one link takes off to the carburetor, and another link runs to the transmission. Adjustment is correct when any movement of the accelerator pedal results in a corresponding movement of the carburetor th ottle plates, and the transmission lever. Because this type transmission uses the pedal stop for a driving aid, the stop screw adjustment is very important.

The "what" and "why" of ball joints

Well maintained ball joints give outstanding long, trouble-free service . . . but when replacement time does roll around, this can be a profitable service, especially when it's handled right.

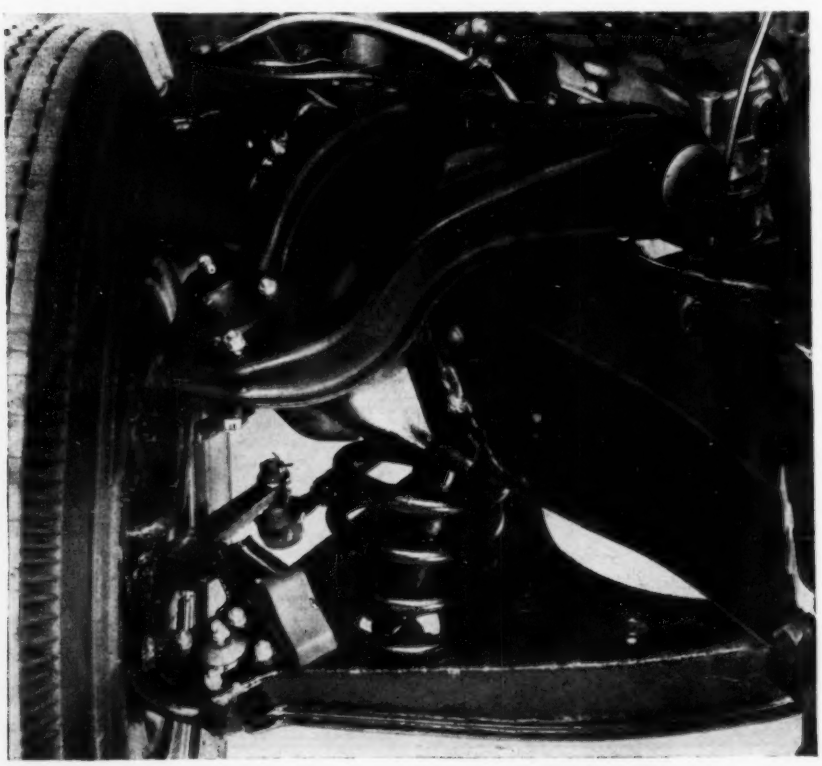
• ONE MIGHT SAY, "American front end suspension systems are 50 years behind the European systems, especially in the field of ball joints." On the other hand, you could reply, "Maybe Europeans had the ball joint idea first, but it took American engineering to perfect it for mass production."

There's some right on each side of the argument. Ball joints were introduced in Europe over 50 years ago. In 1900, Lancaster, an English inventor, obtained a patent for automotive ball joint suspension. It was basically a pusher type in which ball joints were used at the ends of links which connected the front axle and the vehicle body.

In 1920, another Englishman, Heyermans, patented a ball joint design which covered both suspension and steering. Heyermans visioned an upper and a lower ball joint built right into the spindle assembly.

By 1931, automotive designers of other European countries became interested in ball joints for front suspension. In that year, one of Germany's great designers, Porsche, came up with his idea for the use of ball joints. Porsche apparently thought ball joints should be ball joints, not balls on the ends of studs. In his early sketches he designed a suspension system that utilized two free balls—an upper and a lower—held in separate cups. Drawings indicate a threaded adjustment for the upper bearing, but none for the lower. It's also interesting to note that no provisions were made for lubrication or for dust shielding.

Another German manufacturer, Daimler-Benz, entered the ball joint picture in 1932. It originated the idea of building up a ball joint at the end of a stud by assembling several separate parts. These people also introduced ball joint seals, and coil springs to hold the seals in place.



Chevrolet's spherical joint suspension is of clean, simple design. Note the nut and bolt mounting of both the upper and lower spherical joints.

By D. E. HERBERT

About this time, a Frenchman, Sizaire, came on the ball joint scene and designed a method of automatic take-up to compensate for ball joint wear. His device consisted of a coil spring to hold the contact surfaces under constant pressure. Pressure from one direction would come from the weight of the vehicle, pressure from the other direction would be exerted by a coil spring. This design was a step in the direction of controlling chucking or looseness of the ball system.

AMERICAN MANUFACTURERS NOT ASLEEP

American manufacturers were not asleep at the switch while all this was going on in Europe. They knew that the ball joint suspension systems being developed across the pond had several qualities Americans would label undesirable. Among them were hard steering, awkward mountings, and large size.

The number one complaint was hard turning torque, or steering.

"Why," one might ask, "if all these things were wrong with European ball joint systems, were they used?" The answer appeared to be in road conditions and driver tastes.

In Europe, narrow winding roads are the rule; in this country they're the exception. Our cars are built to roll true for many miles with just minimum driver effort. Also, Americans don't demand hard, quick steering; most seem to prefer the slower, easier kind. The average European needs quick steering for safe negotiation of sharp-turn highways.

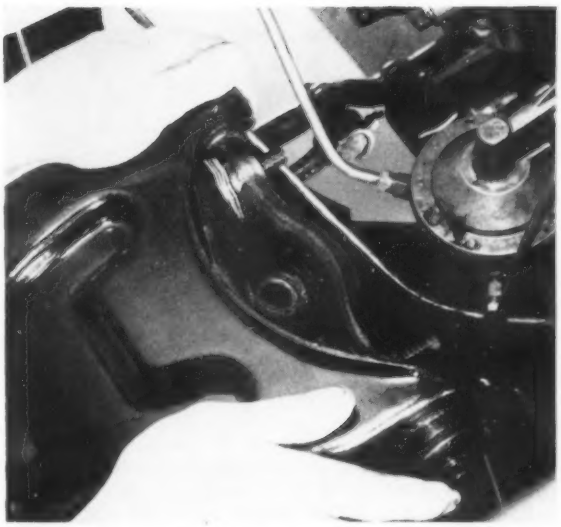
The lower ball joints of some ball joint tune-up kits are adjustable. By turning the adjustment nut with an Allen wrench, you can "tune" the front end to the exact degree of tightness desired. A positive lock stops stud end play.

In the early 1930's Thompson Products, Inc., started experimenting with ball joints. Their first attempt was to design a suspension system somewhat like the European. The results were the same—hard steering.

Further investigation revealed that load-carrying ball joints would always be difficult to steer if a free-turning mechanism was not built into the joint. So, Thompson engineers included a set of ball bearings.

The method of mounting was also discovered to be a main cause of hard steering. Thompson Products solved this by reversing the mounting so that the lower stud was hung on the taper. This removed a large mass from the spindle support, making it possible to place the ball center in a more favorable position from a steering geometry standpoint.

By unique mounting, and building a roller bearing into the lower ball joint socket, American designers overcame the hard steering objection which was inherent in European systems.



Ball joint systems use shims to obtain correct front end alignment. By adding or removing shims at either upper control arm cross shaft, wheels can be brought into specifications.

The American version of European ball joint suspension systems includes many advantages:

- Suspension action and steering motion are combined at one point.
- Dampening control is provided by a spring loaded clutch located in the upper ball joint. This clutch offers satisfactory damping over rough roads without undue steering drag during parking.
- Free-turning action is provided in the load-carrying lower socket.
- Front suspension bind due to misalignment, is eliminated.
- Increased engine compartment space.
- Easily serviced or replaced assembly.
- Greater wheel travel (up and down) can be obtained if necessary.
- Greater durability.
- Brake anchor pins can be attached directly to the spindle support. This reduces necessity of a heavy backing plate, and also reduces braking vibration and noise.
- Reduces unsprung weight.
- Reduces number of front end parts.
- Reduces front end lubrication points from approximately five per side to two per side.
- Anti-dive can be achieved more easily. This is important because currently popular low rate front springs tend to result in front-end dive during braking. Ball joints allow the lower control arm to be mounted parallel to the ground, while the upper arm is inclined about 7° rearward. This arrangement adequately controls the diving tendency.

BALL JOINT SERVICE

With all the advantages ball joints seem to have, it's only logical that service requirements should be few and simple to perform. Usually, well maintained ball joints give outstandingly long trouble-free service. When re-

(Continued on following page)

Ball Joints . . . CONTINUED

placement time does roll around, it's an easy matter to slip in a couple of new joints.

Unfortunately, for the customer at least, many perfectly good ball joints have been branded defective and replaced with new ones; mostly because of misunderstanding on the part of the man who does the inspection.

The design of most lower ball joints is such that when vehicle load is removed from them (car raised with jack placed under lower control arm and wheels free from ground), the joint will have some play. *This is normal.*

Early units were spring loaded to remove this play. Later it was found that the spring was unnecessary because vehicle load keeps the joint snugged up at all driving times. According to Donald Smith, Assistant Chief Development Engineer, Thompson Products, Inc., "It's unfair to condemn a lower ball joint solely on the grounds of looseness when the wheel is off the ground. This condition always exists, and it's perfectly harmless. In fact, a new joint will behave in an identical manner.

"Ball joint testing should involve more than jacking up the front end of a car and shaking a wheel."

DETERMINING NORMAL FREE PLAY

Determining exactly how much play is normal can prove a poser. One good method, recommended by Chevrolet, is to check the upper spherical joint with a torque wrench placed on the stud nut. Torque required to turn the stud should be a minimum of 2 foot pounds. If a tight joint is suspected, maximum torque is 15 foot pounds with a well lubricated joint. If the upper joint exceeds these specifications *both* upper and lower joints should be replaced. There are no means provided for adjustment of the original equipment joints to compensate for excessive joint looseness.

In the replacement field, Moog Industries, Inc., market what they term the K-890 Ball Joint Tune-Up Kit for Ford, Mercury and Edsel cars. This kit includes *adjustable* lower ball joints. A simple adjustment made with an Allen wrench eliminates slack in front-end assemblies resulting from lower ball joint looseness. A positive locking arrangement prevents stud end play.

Moog engineers feel that lower ball joints should be adjustable so that they can offer the following advantages:

- Simplified wheel balancing.
- Positive front-end adjustment.
- More stable front-end suspension
- Less noise and vibration.

Joints mount flush against control arms—no gaskets or shims are used. A grease fitting is part of the original equipment. Replacement joints are "gusher type," and "breathe" oil under friction or pressure.

Spherical joints and ball joints are very similar in appearance. In operation they are practically identical. With the exception of a few current makes of cars, ball and spherical joint suspension have swept the industry.

REPLACEMENT PROCEDURE

Ball joint replacement can be accomplished quickly, and with a minimum amount of special tools. To replace an upper ball joint on a Ford, for example, start by raising front end of vehicle and placing safety stands under the lower control arms. Remove wheel and tire as an assembly. With a large chisel, cut off the upper ball joint retaining rivets. Do not burn rivets off with a torch, as heat can cause fatigue and failure of the control arm.

Remove the upper arm suspension bumper. Remove the cotter pin and nut from the ball joint stud. Position the special ball joint remover tool between the upper and lower joint studs. Tool should seat firmly against the ends of both studs, not against the lower stud nut. For convenience and safety's sake, a box wrench should be slipped onto the tool *before* the tool is positioned on the studs. However, the tool can be worked using an open end wrench of the correct size.

Turn the wrench to spread the tool until both studs are under tension. Then, use a hammer to tap the spindle near the upper stud. The stud should be loosened from the spindle through the combined force of tool tension and tapping hammer, never by tension alone. With joint loosened, remove tool and joint.

Inspect control arm carefully, and if arm is cracked or otherwise damaged, it should be replaced. If arm is in good condition, clean off mounting area, and install new ball joint. Special bolts and nuts are supplied with replacement kits, which should always be used. Do not try to rivet a new ball joint in place.

Torque the mounting nuts to 28-45 foot pounds. Install upper arm suspension bumper and torque nut to 20-35 foot pounds. Position ball joint stud in spindle bore. Torque retaining nut to 60-80 foot pounds, and install cotter pin. Lubricate the new joint, and install the wheel and tire. If the lube facilities are far removed from the work stall, give the joint a shot of grease before it is installed.

Remove the safety stands, and lower the vehicle to the floor. Then, check front end alignment. This is very important whenever any part of the front suspension has been removed and replaced.

Replacing the lower ball joint is almost identical with the exception of working around the coil spring. While the above procedure is pertinent to Ford only, it is applicable to all cars using ball, or spherical, suspension.

Say You Saw It In Automotive Service Digest

Hits Service Jackpot by Offering Free Bumper-To-Bumper Inspection

• WHEN MANAGEMENT of Stevens Buick Corp., Mt. Vernon, N. Y., recently decided to conduct a three-day automobile clinic by offering free bumper-to-bumper inspections to all cars driven into their establishment, little did they realize that they were in for a record-breaking volume of service.

Featured in the bumper-to-bumper inspection was a complete engine analysis with the concern's DuMont TV-Type EnginScope, and according to John A. Fuller, Stevens' service manager, "without the 'scope' we would have never dared to undertake the clinic."

Elaborating on his strong stand for oscilloscope testing of automobile engines, Mr. Fuller declares that the time involved for engine analysis with regular meters in a clinic-type undertaking would be prohibitive.

"First, and most important," he says, "we would have lost our shirts without the EnginScope. Extra help would have been needed to pull spark plugs, check out distributors, and inspect the other components in the ignition system. We would have been working around the clock and still wouldn't have been able to check out everything we could with the oscilloscope.

"Second, traffic would have been blocked outside the shop with an overflow of cars waiting for their inspections."

"And last, the engine inspection couldn't possibly be as thorough with a regular meter because the 'scope' shows you a dynamic presentation of the engine operation while it is running."

65 PER CENT MAKE SERVICE APPOINTMENT

With two "scopes" working in the engine analysis area, 88 cars were taken through a thorough inspection during the three-day clinic and resulted in on-the-spot appointments for service from 65 per cent of the cars tested . . . with the resulting appointments for service since the conclusion of the clinic still mounting as this is written.

Taking advantage of dealership's free bumper-to-bumper inspection, a car owner looks on as mechanic explains what the lines on the "scope" indicate about the condition of the car's engine.

In addition to the "scope" analysis, each automobile was given a hoist check at which time the brakes were inspected; wheel bearings were packed, free of charge; and the entire exhaust system and undercarriage were checked. Following the hoist inspection, the automobile was put through a front-end inspection which included caster, camber, tow-in, steering, and linkage checks. Another service area was set up for testing all lights, accessories, and windshield wipers. At this stage, interiors were brushed, ashtrays emptied, windshields cleaned, etc. For a final check, a Buick zone representative took the automobile for a road test.

In the engine analysis area, the "Scope" was hooked to the autos by two simple spring-clips. By viewing light patterns on the instrument's screen while the engine was in operation the mechanic could instantaneously pinpoint a wide variety of automotive troubles including fouled, misfiring, open or shorted spark plugs; defective coils, condensers, wiring and switches; worn distributor cam and shaft bearings; and burned distributor points.

"And all that in a quarter of the time it would have taken to analyze an engine with standard meter procedures," exclaims Mr. Fuller. "We're convinced we could have handled three times the load, and we'll prove it the next time we hold a clinic."

TURNOUT WAS DISAPPOINTING

He points out that attendance was not as large as had been expected because of detrimental weather, and the Wednesday, Thursday, and Friday scheduling. "When we hold the next clinic," Mr. Fuller stated, "a Saturday will be in the schedule and so will a Thursday after 5:00 P.M. By limiting our clinic to weekdays, 8:00 A.M. to 5:00 P.M., we kept out the man of the house."

The purpose in holding the clinic, according to Mr. Fuller, was to build up the service operation at the Westchester dealership and to corral delinquent service accounts.

Duplicate inspection reports were made out, one for the customer and one for the active files. As a follow-up, the motorist whose car needed repairs, as indicated by the report, was personally contacted by telephone at his or her office or home.

"Of course they're cheap, inferior parts . . . That's part of our low overhead!"

To make your shop more profitable . . . your time more valuable . . . be sure to read this month's "These Are New" section

By STOKES TAX CONTROLS, INC.

Tax guide and business briefs

√ Common sense and hard work the answer

• THERE IS NOTHING wrong with our economy that can't be cured by common sense and hard work. We have been exposed to a multimillion dollar publicity program that we are all going to the dogs. The majority of the 1958 businessmen and 80% of the labor force are too young to have experienced the pre-war depression. Those of us that went through the 30's know what we did then and what we have to do now to get business.

Reports on business conditions are conspicuous by the variances between localities. There are still automotive outfits doing all right even though their profits are down. People seem to be suffering from uncertainty, not gloom. Most people feel things will run on at about the present level for the rest of the year. If previous years were "normal," a return to those conditions is too far distant to just "wait and hope." The safe course is to assume that present conditions are normal. Get set to break even at present sales volume and then go after more and better business. If automobile sales are down, people are driving the old cars which means more business for service organizations.

There are various campaigns in progress to promote optimism. Don't regard this as something for the other fellow. Success in any business starts with enthusiasm and the boss man knows that his attitude will be the attitude of his subordinates. "People sell people."

ASK FOR THE BUSINESS

The first job is to sell more merchandise at more profit. Sell your product and don't rely on gimmicks like pack, excess financing, etc. Articles in the Wall Street Journal and other publications indicate that the salesmen are not asking for the business. They don't go out and hunt it. No one has ever asked your editor to buy an automobile in the last ten years and we need one. Your editor went into a Chevrolet showroom in Los Angeles the other day and spent fifteen minutes examining a car and the three salesmen in the corner never moved. In a Dallas Buick place, the salesman wanted to know first what the trade was and how much.

The "You Auto Buy Now" drive in many cities is great. It is giving young salesmen new material. The kick-off speech in Madison Square Garden merited a lot of thought. Here are a couple of the slogans there:

- **Champ or Chump**, "U" make the difference.
- If 8% of the people are unemployed let's sell the other 92%.
- Beat the drum and people listen.

Whether you sell automobiles or related items, there is plenty of food for thought and plenty of benefit to you in the "You Auto Buy Now" drive.

FIND OUT WHY EXPENSES ARE UP

The other side of the problem is expense control. You can use your own records for comparative figures. 1955 was a good year for most people. Lay your financial statement for the year-to-date alongside the one for the same period in 1955. If you don't have monthly financial statements, get your accounting straightened out fast. You can't pilot a fast moving business or an airplane without detailed information.

Most businesses find that 1958 expenses are higher than 1955. Dig in and find out why. Then get moving to correct the conditions. One automotive organization lost $5,500.00 in the first quarter of 1958. If they could cut 1958 expenses to the 1955 level, they would save $4,000.00 per month. Certainly, this tells us that a cut of $1,000.00 per month is possible and that means a black nut for 1958.

In another organization in the red, the following changes put them in the black:

- Replaced sales manager with the owner.
- Employees required to pay own group insurance.
- Eliminated one service salesman.
- Charged 50c for car pick ups and deliveries.

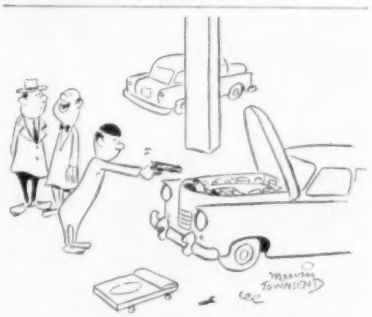
Let's check just one more example: A Chevrolet dealer in a metropolitan area lost $3,600.00 in 1955 and $21,000.00 in 1956 and turned it into a profit of $16,688.00 in 1957. He made $2,700.00 in the first three months of 1958. Gross profit from sales was the same in 1956 and 1957. He cut his expenses $3,000.00 per month.

The article in this column for January 1958 gave suggestions for controlling expenses and urged the preparation of a 1958 forecast. If you set up a 1958 forecast, it is probably a sad comparison with actual results, but that is all the more reason for a thorough revision of your projection.

TABULATE NEEDED IMPROVEMENTS

Make a list of the improvements to be made in your operation. Your job is to get one erroneous condition corrected each day. Have your place "shopped" and find out the reaction that strangers get from your employees.

This expense cutting operation is about as tough as taking it off your waistline. It takes an iron man to get the job done. There are automotive businesses that are making money in 1958. It must be done! It can be done! It will be done! Do your part to prove there is no recession.



"When he says a battery's dead, he really means it!"

No Room for Sediment

When a car owner complains of surging and power loss, you may save yourself some embarrassment by checking the fuel filter and sediment bowl before tearing into the carbu-

retor. In fact, it's a good idea to make such a check a part of your dewinterizing program—changing temperatures may have caused the formation of water in the gas tank.

If you find water and dirt in the sediment bowl, clean it out and wash the filter with solvent or replace. Reinstall the bowl carefully—so that the gasket seals properly—and check it for leakage. Then, recommend the addition of a good fuel system de-moisturizer to the tank.

Push Rods Too Long . . . Or Installed Upside Down?

After receiving reports of starting failure on overhauled 350 or 361 cu. in. Dodge engines, the Dodge Service Department found on examination that the push rods in the engines appeared to be ⅛″ too long, thereby holding the valves partially open.

This condition results from installing the push rod in an inverted position. The top—or rocker arm—end of the rod is approximately 5/16″ diameter; the lower—or tappet—end of the rod is ¼″ diameter, as is the seat in the tappet.

When the push rod is installed upside down, the large end of the rod will not seat in the tappet and rides instead on the top of the plunger, increasing the effective length of the rod by ⅛″.

When Replacing Oil Seals Examine Shaft for Defects

When replacing axle shaft inner oil seals to correct lubricant leakage in the rear wheels of 1957 and '58 Chrysler and Imperial models, the factory recommends that the seal be properly lubricated and the appropriate seal driver be used. It is also recommended that the axle shaft be carefully inspected in the areas approximately 8″ from the tapered end and approximately 6″ from the splined end. If the inspection shows any indications of raised metal due to the indentations on the axle shafts in these areas, the raised metal should be dressed off either with a file or by grinding. It is also suggested that the splines be carefully inspected for excessively sharp edges and that the sharp edges be dressed with a stone.

When installing the axle shaft, be careful that you do not drag the splines across the seal surface, since the splines may damage the seal surface to the extent that it will affect its ability to retain the lubricant.

Car Taxes Noted

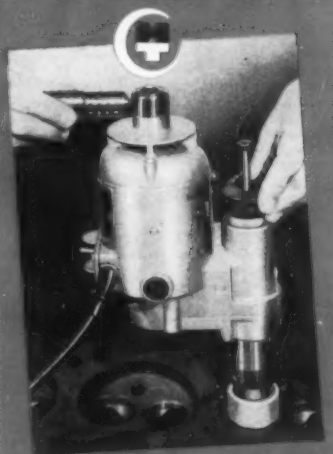
About one-fourth of each dollar spent to buy cars and trucks in the U. S. today goes for state and federal taxes, according to the American Finance Conference, national association of independent sales finance companies.

A Michigan buyer, for instance, will pay about $600 in taxes for the purchase of a car costing $2,500. All told, the nation's motor vehicle buyers paid some $8.2 billion in special automotive taxes last year. This compares with a total of $7.9 billion in 1956 and only $3 billion in 1947.

a good seat makes the big difference!

WATCH YOUR PROFITS GROW WITH

HALL TOLEDO



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Only HALL-TOLEDO, with the exclusive eccentric grinding principle used in its MODEL EJ VALVE SEAT GRINDER, can assure the best possible performance and operating economy which is the result of perfect valve seating.

Whether you do your own valve work or have an engine service organization do it for you, be certain that HALL-TOLEDO equipment is used for faster, factory approved precision valve seat grinding. The Model EJ set will handle valve seats up to 3″ diameter. HALL-TOLEDO pilots and grinding wheels make this valve seat grinder adaptable for service on all automotive engines.

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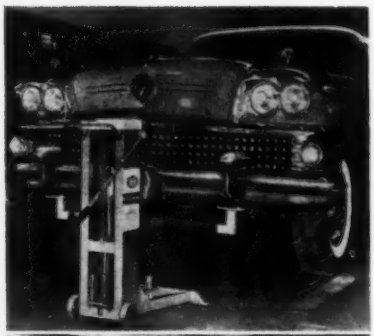
Valve Seat Grinders for Automotive, Diesel and Aircraft Engines • Valve Guide Reamer and Seat Inserter • Expanding Pilots, Grinding Wheels • Cylinder Hones • Multiple Spindle Grinders for Factory Production

HALL-TOLEDO, INC.
2931 South Avenue, Toledo 9, Ohio

How to lift 1958 cars

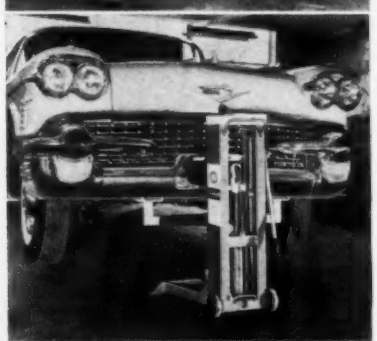
Using a 1-end bumper lift jack can speed up many types of service jobs . . . but when using this equipment on cars with air suspension, smaller wheels and new style grilles and bumpers, be sure you use it properly, or you may find yourself in trouble.



BUICK—*Front:* Lift on bottom of bumper directly under bumper guards with saddles spread 48". *Rear:* Lift on frame cross member with saddles spread 46". Check for gas tank clearance. DO NOT lift by bumpers except where jointed just inboard of tail light.

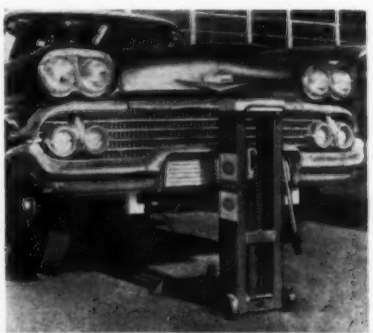
With Air Suspension: Pull out lift control knob under instrument panel. After lowering and jack has been removed, push in control knob.

Photos and instructions courtesy Blackhawk Mfg. Co.



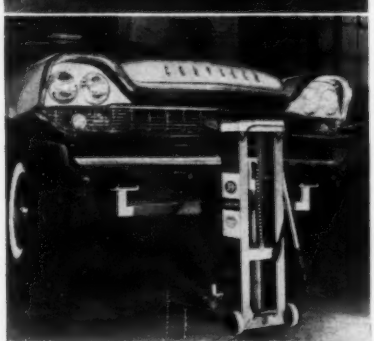
CADILLAC—*Front:* Lift on bumpers with saddles spread 36". *Rear:* Lift on rear cross members with saddles spread 43", or on bumper with saddles spread at least 24".

With Air Suspension: Pull out air lift handle below instrument panel before jacking. Push handle back in after lowering car.

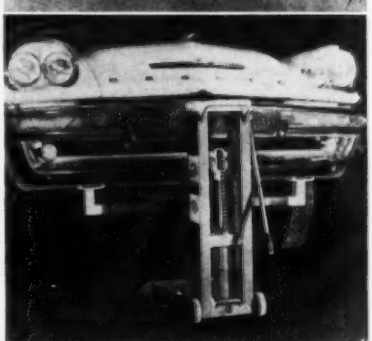


CHEVROLET—*Front:* Lift on brackets just behind bumper joint with saddles spread 40" or on bumper anywhere between joint and outer bracket bolts. Do not lift at center section. *Rear:* Lift on cross member with saddles spread 40" or on bumper between joint and outer bracket bolts. Do not lift at center section.

With Air Suspension: Close shut-off valve under hood before lifting. Re-open valve after car has been lowered.

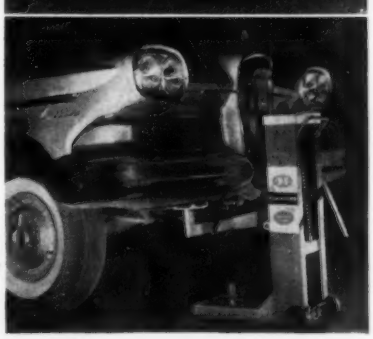


CHRYSLER—*Front:* Lift on bumpers, where notched, with saddles spread 48". *Rear:* Lift on bumpers with saddles spread 48".



DE SOTO—*Front:* Lift on bumpers below notches, with saddles spread 48". *Rear:* Lift on frame cross member or bracket with saddles at 41", or on bumper, with saddles spread 48".

DODGE—*Front:* Lift on frame extensions or on bumpers, where notched, with saddles spread 48". Stay clear of center deflector skirt. *Rear:* Lift on frame cross-member behind bracket bolts after checking for tail pipe clearance, or on bumpers, below bolts.



EDSEL—*Front:* Lift on support brace behind bumper with saddles spread 40". Bumper lifting is not recommended. *Rear:* Lift on frame cross member with saddles spread 37". Watch for gas tank clearance. Bumper lifting is permissible.

With Air Suspension: No precautions are necessary.

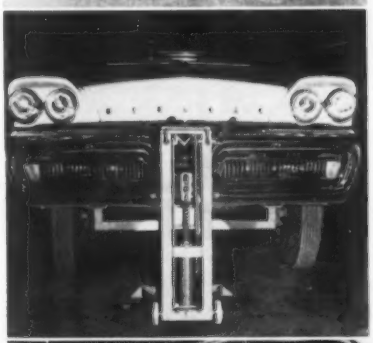
FORD—*Front:* Lift on brackets with saddles at 42" or on bumpers at same spread. *Rear:* Lift on brackets with saddles at 48" after checking tailpipe clearance, or on bumpers at same spread.

With Air Suspension: No precautions are necessary.

IMPERIAL—*Front:* Lift on bumpers below notches, with saddles spread 48". *Rear:* Lift on bumpers below notches, with saddles spread 48".

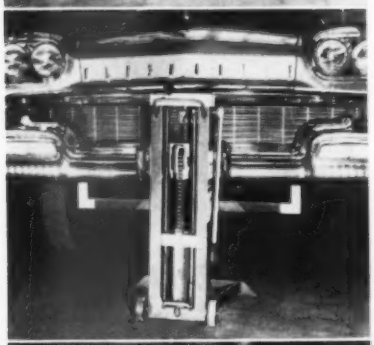
LINCOLN—*Front:* Lift on bumper at jack pad with saddles spread 48". Be sure front ears of saddles hook behind edge of bumper. *Rear:* Lift on bumper at jack pads only, with saddles spread 48".

With Air Suspension: No precautions are necessary.



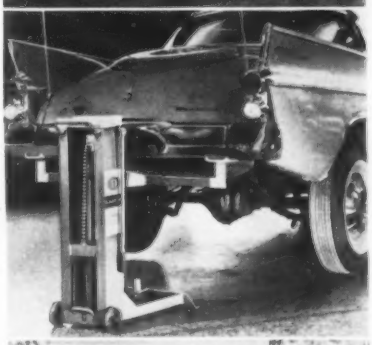
MERCURY—*Front:* Lift on bumpers below jack slots, with saddles spread 42". *Rear:* Lift on frame cross members after first checking gas tank clearance, or on bumpers, where notched, with saddles spread to 48".

With Air Suspension: Be sure all doors are closed before jacking. No other precautions are necessary.

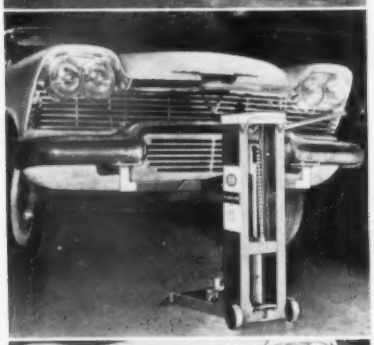


OLDSMOBILE—*Front:* Lift on front cross member with saddles spread 45". Bumper lifting also acceptable. *Rear:* Lift on frame cross member with saddles spread 36" after checking for gas tank clearance. Bumper lifting also acceptable.

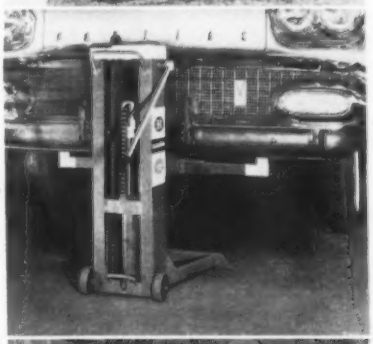
With Air Suspension: No precautions are necessary.



PACKARD—*Front:* Bumper or bracket lifting will damage car. Use a service jack for lifting on frame between wheels to raise entire front end. *Rear:* Lift on bracket after checking for tailpipe clearance or on bumper below bracket bolt. HAWK—Lift on bumper outside of tailpipe with saddles at full spread of 48".



PLYMOUTH—*Front:* Lift on bumper beneath bracket bolts with 46" saddle spread. Do not contact lower grille panel. *Rear:* Lift on bumpers beneath bracket bolts with 46" saddle spread. Do not contact middle lower bumper or outer deflector skirts.

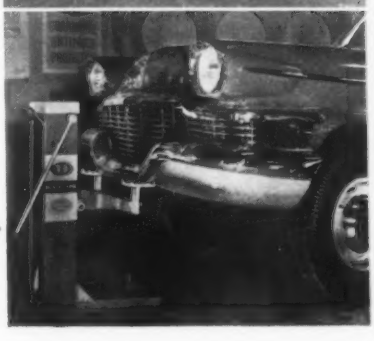


PONTIAC—*Front:* Lift on outer bumper bracket, with saddles spread 41". Bumper lifting is not recommended. *Rear:* Lift on frame cross member with saddles spread 38". Bumper lifting is not recommended.

With Air Suspension: Start engine and pull out car lift knob under instrument panel. Stop engine after car stops rising and before jacking. After lowering car, push car lift knob back in.

RAMBLER—*Front:* Lift on brackets behind bumper guards with saddles at 41". Bumper lifting is not recommended. *Rear:* Lift on frame cross member with saddles at 44". Bumper lifting is not recommended.

With Air Suspension: No precautions are necessary.



STUDEBAKER—*Front:* (Scotsman, Champion, Commander, President) Lift on middle portion of bumper with saddles at 27". Do not contact deflector shield below bumper. HAWKS—Lift on bracket with saddles at 36". Bumper lifting permissible.

Rear: (Scotsman, Champion, Commander, President) Lift on brackets with saddles at 48" after checking tailpipe clearance, or on bumpers below bracket bolts. HAWKS—Lift on bumpers below bracket bolts with saddles spread at 26".

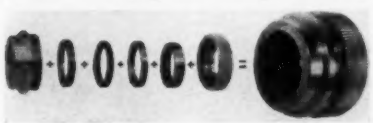
These are new *manufacturers' products*

HOW TO GET RUSH INFORMATION

If you want further information or literature describing the products shown in our "These Are New" pages, just use the handy Business Reply Card you'll find further back in this issue. Whether you want information on one or more of the products, all that is necessary is to mail this Postage paid card properly filled out to AUTOMOTIVE SERVICE DIGEST. Our Reader's Service Dept. will contact the manufacturers directly and see that you obtain the requested information as quickly as possible.

New Bearing Oil Seal

The Seal-O-Matic, a new bearing oil seal recently announced by Traction Master Co., is a precision engineered unit designed to correct one of the irritating and costly faults in



most of our high-torque, powerful automobiles—the drive line "clunk" or "snap."

The unit has double bearing surfaces to provide true and constant alignment of the transmission output shaft and the drive shaft—preventing the eccentric rotation which causes "snap," as well as vibration and wear.

Along with this all-important performance function, the Seal-O-Matic is said to provide ample seal protection against transmission oil leakage —and provide that protection permanently.

(Use Reply Card for Further Information)

Spare Tire in a Can

"Spaire," a new product being offered by Liquid Glaze, Inc., not only inflates an average sized tire from zero up to 22 lb. in six seconds, but it is also said to provide motorists with a most effective fire extinguisher.

And in addition to many other inflation jobs that may arise, it is said to be most effective in eliminating fuel pump and fuel line vapor lock, and just the thing for "drying-up" condensation on spark plugs, distributor, wiring, etc.

(Use Reply Card for Further Information)

Automatic Hot-Cleaning Vat

A new Hot-Cleaning Vat, which is said to clean radiators better, faster and easier, has just been announced by the Inland Mfg. Co.

Cleaning action is speeded by a vigorous agitation of the solution, pro-

duced by air streams upward through the tank—3 along the front side and 3 along the back side.

An easy-to-set Memory Master time switch automatically turns the heat ON at any pre-determined time so the solution is hot and ready to use when the operator arrives—and turns it OFF at closing time. In other words, it can be set to have the solution hot at 7 each week-day morning . . . off at closing time. Also, off at any desired time on Saturday to remain off until the proper time Monday morning. Once set, the automatic switch continues to operate without attention day after day, week after week. The setting is easy to change for holidays, etc.

Handy control panel combines temperature gauge, temperature control, air gauge, air regulator control, air agitation switch and elevator-and-lid control.

(Use Reply Card for Further Information)

Top Cylinder Lubricant

"Top 500" Engine Conditioner Oil was specifically formulated for use in the De Paolo "500" Turbo-Injector—a new upper cylinder lubricator that converts the oil into a mist which combines with the air-fuel mixture to provide constant lubrication and conditioning as the engine requires it. In the absence of the injector, the lubricant can be introduced through the gas tank or carburetor.

According to the De Paolo Engineering Co., "Top 500" is a non-acid, heat-resistant, all-weather detergent and lubricating oil—scientifically compounded to blend with all grades of gasoline. It is said to act effectively to remove gum, varnish, carbon, sludge—coating metal surfaces with a protective molecular film to eliminate sticky valves and rings, and improve power, mileage and performance.

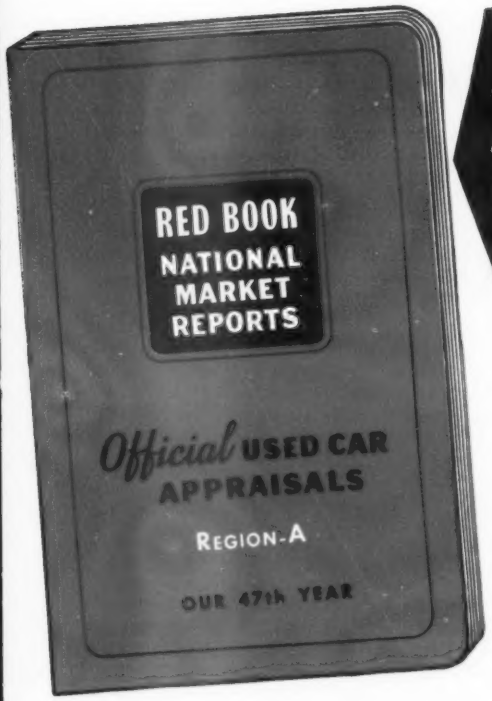
(Use Reply Card for Further Information)

Muffler-Tail Pipe Cutter

Rinck-McIlwaine, Inc., announces a new muffler and tail pipe cutter designed especially for work in close quarters or at the workbench. Four sharp, sturdy cutters make full contact; centered handle allows fullest possible swing. The tool is adjustable from ¼" to 2½" to handle the requirements of all popular passenger cars and light trucks.

(Use Reply Card for Further Information)

Say You Saw It In
Automotive Service Digest



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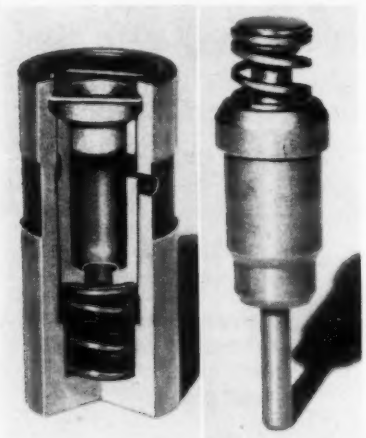
These are new *manufacturers' products*

Zero-Lash Hydraulic Valve Lifts

A full line of zero-lash hydraulic valve lifters has been added to the valve train product lines of McQuay-Norris Mfg. Co. for replacement on all cars and trucks equipped with hydraulic valve lifters.

Among the many advantages



claimed for the lifters are the patented combination check valve spring and retainer housing, which is said to assure instantaneous closing of lifter check valve. Pre-lubrication assures that the lifters are ready for instant use. The bottom of the tappet is Parko-lubrized for initial run-in protection.

A further advantage claimed by the manufacturer is the standardization of lifter design to provide better coverage with fewer numbers than possible with other hydraulic lifter lines.

(Use Reply Card for Further Information)

Acrylic Lacquer Line

Because of the continued increase in the use of acrylic lacquers in the automotive field, the Sherwin-Williams Co. announces a complete line of such lacquers to the automotive refinishing trade.

To solve the problems repair of cars finished with acrylic lacquers poses, Sherwin-Williams is offering a two-pronged program.

Acrylic lacquer colors currently in use are now available in factory-filled packages under the trade name Opex Acrylic Lacquer. The number of such colors will be increased as car manufacturers switch over to additional colors in future productions.

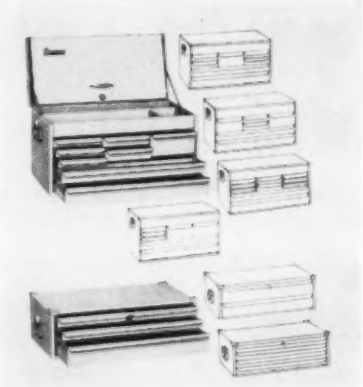
The second part of the program is based on a new Opex Acrylic Mix, augmented by new Hi-Strength White and Silver mixing lacquers. Any combination of the Acrylic Mix and either or both of the new mixing lacquers can be tinted with the familiar Opex lacquer mixing colors, which is said to give refinishers the same infinite range of tints and shades they have long enjoyed in the nitrocellulose field.

According to E. W. Windsor, general manager of the paint firm's automotive division, the Opex Acrylic Lacquer refinishing system overcomes the many perplexing problems formerly encountered in the use of acrylic lacquers. "For example," he said, "Opex Acrylic Lacquer requires only a single thinner instead of a combination of special thinners. Furthermore, no special undercoats are needed, since the lacquer can be applied over any Opex Lacquer Primer Surfacer. In addition, the new acrylic lacquer can be applied over an old lacquer surface when simple precautions are taken. And, of course, the new lacquer can be tinted as easily as the regular nitrocellulose finish, using standard color mixing equipment."

(Use Reply Card for Further Information)

Tool Storage Units

Snap-on Tools Corp. announces a new tool chest with changeable drawer features which enable a mechanic to design his own tool storage unit to meet his own particular requirements. All deep drawers, all



shallow drawers, or a combination of deep, shallow, and medium-depth drawers can be selected to provide the right combination for a specific operation.

All drawers are non-sag, non-spill, easy running units with full width, roll-type pulls for easy opening from any angle. Overall dimensions of this tool chest are 26"x12"x14" high.

Also available is a drawer section designed to fit under the tool chest mentioned above—and available with the new changeable drawer feature. Two shallow drawers can be substituted for the deep drawer or a deep drawer can be substituted for the two shallow drawers. Several drawer sections can be stacked vertically as four raised corners on top of each section permit "nesting" of units. Overall dimensions of the new drawer section are 26"x12"x8" high.

(Use Reply Card for Further Information)

Marine Engine Emergency Kit

A new moisture-proof emergency repair kit consisting of a contact and condenser assembly, and featuring corrosion-resistant packaging for safe stowing has been announced by The

Electric Auto-Lite Co. for owners of inboard engines.

Available in four different combinations of contact and condenser assemblies for wide coverage of inboard engine makes, the kits are formed from durable polyethylene film which protects the electrical parts from corrosion due to moisture and insures reliable emergency repairs with original equipment parts.

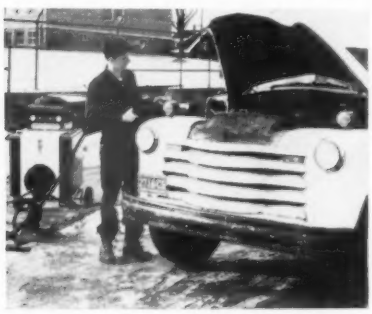
The parts in these kits are the same as those produced by Auto-Lite for nine out of the ten inboard engine builders for pleasure craft. The condenser is plated and hermetically sealed for added protection against moisture and the contact set features stainless steel springs for most applications.

(Use Reply Card for Further Information)

Steam Cleaner Line Improved

John Bean's improved steam cleaner line, which is said to be easier and faster to operate, is offered in a variety of models—stationary units, portable units with casters, portable units with pneumatic tires or trailer mounted.

In the John Bean cleaner, a special



detergent compound is combined with high-pressure steam and completely vaporized in the coil section of the unit—to convert 100 gallons of cold water per hour into steam under 100 p.s.i. According to the manufacturer, the cleaner is ready for action only two minutes after the switch is turned on.

Heart of the cleaner is a new type positive-action diaphragm pump that supplies balanced amounts of both water and fuel. To operate the cleaner, only two controls are necessary—one to regulate the burner heat and the other to regulate the detergent solution to any desired strength.

Burner clogging is said to be eliminated by a heavy-duty fuel filter with replaceable filter cartridge, and safety is assured by an exclusive fuel metering system and pressure-relieve valve and an air-cooled gun.

(Use Reply Card for Further Information)

Improved Formula for Metalife

A new, improved formula for Metalife is announced by Liquid Power Division of the Metalife Co. The product is said to add to lubricating oils all of the properties necessary to prolong engine life, free up sticky valves, valve lifters, piston rings, and combat acid corrosion and premature wear.

It is commonly known that most wear occurs in the warming-up period (especially in cold weather) in the first two or three minutes of engine operation. Automatic choking of the carburetor to enrich the mixture for starting often washes engine oil from bearing surfaces, and according to the manufacturer, Metalife puts a tough lubricating oil film on all parts in the engine reached by the regular oil. The purpose of this is to prevent metal-to-metal contact, thereby reducing heat, friction and wear.

The maker points out that the film clings to these parts and will not run off during the starting and warm-up period or when standing for long periods of time. It is stressed also that an engine is always pre-lubricated regardless of temperature ranges either hot or cold.

For sticky valves and valve lifter clatter the engine is brought to normal temperature and operated at fast idle. A one pint can of Metalife is then poured through the carburetor air intake. Next, the crankcase is drained and flushed, filter replaced and one quart of the regular engine oil is replaced with one quart of Metalife.

On new or rebuilt engines, the product is not used until the break-in oil is changed in order to seat the rings.

(Use Reply Card for Further Information)

Bar's Leaks Now Pelletized

Bar's Leaks cooling system protective additive is now being produced with a pelletized sealer that breaks down to particles 15/1000 of an inch —fine enough to flow through the

newly designed cooling system and car heater tubes which now range from 23/1000 to 70/000 of an inch.

According to the manufacturer, as soon as Bar's Leaks (no mix, no shake) is poured into the radiator, the Rhizex sealing compound pellets move to the tops of the water cores. Then, slowly dissolving to particles 15/1000 inch and smaller, they flow with the coolant to keep the cooling system and heater in top condition.

(Use Reply Card for Further Information)

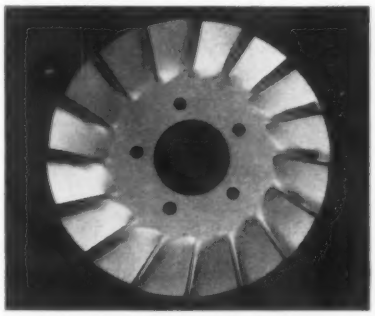
Liquid Rust Wrench

A new Duro Liquid Rust Wrench is announced by Woodhill Chemical Sales Corp. which is said to cut through tight joints to free up frozen connections, nuts, bolts and couplings.

(Use Reply Card for Further Information)

Brake Drum Cooler

Misco Corp. announces a new automotive brake drum cooler turbine for installation between the wheels and brake drums on all cars and trucks



equipped with 14″ and 16″ rims. According to the manufacturer, the amount of air flowing over the brake drum increases with vehicle speed, giving a cooling action of as high as 300°F., so as to prolong brake lining life and eliminate brake fading.

The turbines are packaged in sets of four, two right and two left, and fit over the standard wheel studs.

(Use Reply Card for Further Information)

Coated Abrasive Body File

Difficulties in sanding plastic filler are said to be overcome by the use of the new Adalox Body File being offered by Behr-Manning Co.

The file is a device holding a 2¾″

x 17½″ sheet of 40-D aluminum oxide abrasive paper. The abrasive is secured by clips at each end and the entire device fits standard body file holders or handles.

Advantages claimed for the new device over previous methods include: substantial reduction in cost, faster cut, does not gouge, quickly cuts down rises and waves to the required surface, and the filler can be sanded without extreme loading.

(Use Reply Card for Further Information)

These are new *manufacturers' products*

Small Engine Cylinder Hone

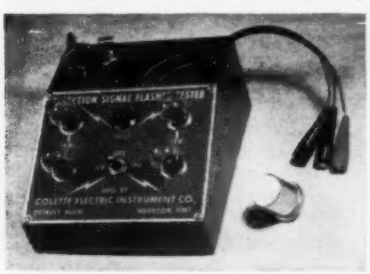
To facilitate the honing of small engine cylinders with a drill press, Ammco Tools, Inc., announces a new

universal drill press drive as an accessory for use with their Model 3950 small engine cylinder hone. The unit (No. 3949) attaches to the hone's drive shank and chucks into the drill press.

(Use Reply Card for Further Information)

Signal Flasher Tester

When turn signal lights go out, the service man can save time and headaches by first checking the flasher unit with the flasher tester being offered by the Colette Electric Instrument Co. If the flasher unit checks OK, only



then need he start looking for fuse, wiring or light troubles.

Three battery clips connect to the battery as required. Two or three clips hook to the directional signal flasher unit to be tested.

The unit will handle any type of flasher on the market today. By a flick of the switch, it will handle either a 6- or 12-volt unit with either two or three terminals. Battery clips hook on to two 6-volt batteries in series for 6- or 12-volt units. Also, the tester will function efficiently on two 6-volt dry cell batteries in series for 6- and 12-volt flashers. The lights then operate as on a vehicle indicating whether the flasher is operating properly front and back.

(Use Reply Card for Further Information)

Electric Fuel Pump

A new electric fuel pump adaptable to any gasoline engine used for any purpose is announced by the Instrument Division of Stewart - Warner Corp. The new pump (Model 240-A) is said to be capable of delivering up to 60 gallons of gasoline per hour to meet the requirements of today's largest truck or bus engines as they operate at full speed.

The pump also features an adjustable, built-in automatic pressure regulator which prevents the pump from putting forth higher pressures than the pre-determined setting, while at the same time permitting the pump to operate at its full power in delivering fuel. The regulator also acts as a surge chamber and evens out the flow of gasoline to the carburetor.

The pump works independently of the engine and starts to work the instant the ignition switch is turned on. It fills the carburetor float bowl before the starter turns the engine over, assuring faster starts.

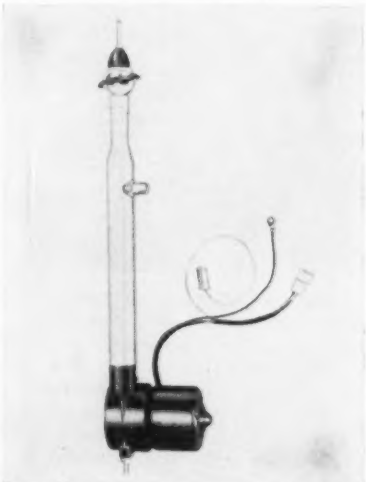
When the pump is mounted outside the engine compartment—preferably back near and at a level with the gasoline tank—it keeps the fuel line to the carburetor under pressure and tends to prevent the formation of vapor in hot weather or high altitudes. Should vapor appear in the fuel line, the pump will operate at an accelerated speed until the vapor is expelled.

(Use Reply Card for Further Information)

Power Antenna

A new electrically operated, disappearing type auto radio antenna, is now being offered by The Merlin Mfg. Co., Designated as the Model TM-1 Tennamatic, this universal mounting, motor-driven antenna, utilizes a patented thrust-limiting clutch, which is said to prevent "motor burnout", the major cause of failure.

The telescoping mast extends or retracts in a maximum of ten seconds. The unit's 15 pound thrust is said to assure free action even in zero weather, and the motor, operated on 12 volts DC, draws a maximum of ten amperes. The housing is treated with

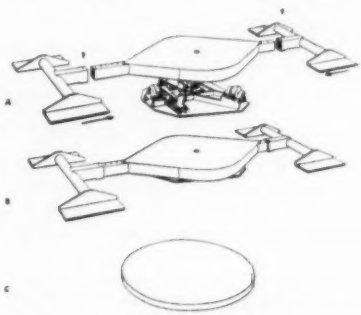


special waterproofing compound, and quick mount leads and fast disconnect plugs are provided.

(Use Reply Card for Further Information)

Display Turntable

An automobile display turntable is being offered by Macton Machinery Co. which can be easily transformed into an engine or accessory display



platform through use of a 4' diameter interchangeable steel top capable of holding up to 2,000 pounds.

The turntable is especially designed for the center of gravity of the modern car, and is almost invisible when in use. Wheel pads are 120" on center, overall width is 67", and height of wheels from the floor is approximately 2".

(Use Reply Card for Further Information)

Say You Saw It In
Automotive Service Digest

Fuel Filter Kit

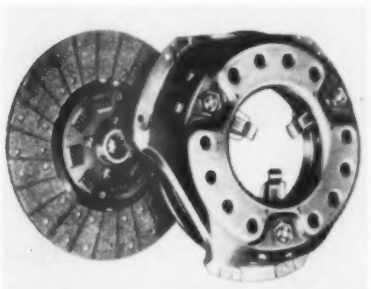
A new gasoline fuel filter kit which will trap dirt particles as small as 2.5 microns in size, is announced by Purolator Products, Inc. Because of its large filtering area, the company states the new fuel filter element will only need replacement after every 10,000 miles of driving.

For new cars and trucks that come from the factory already equipped with fuel filters, Purolator has also developed a new replaceable element which, however, because of its smaller filtering surface will need to be changed after every 4-5,000 miles of driving.

(Use Reply Card for Further Information)

Heavy-Duty Clutches

The first of a new DPB series of direct pressure, heavy-duty clutches, especially for truck, tractor, bus and industrial use, is now being offered by Lipe-Rollway Corp. A 12" single plate unit, the new dry disc clutch is rated for engines up to and including



300 ft.lbs. gross torque. Facing area is 115.4 sq.in. with a unit pressure up to 27.8 p.s.i. Maximum release bearing load is 464 lbs. at full release.

Chrome silicon cylindrical type pressure springs, together with insulating washers under each spring, are said to provide exceptional resistance to fade and maintain a more constant clutch torque capacity, assuring longer clutch life.

The steel stamped cover is well ventilated to expel friction heat and dust, and internal clutch lever linkage is available with optional needle bearing construction.

(Use Reply Card for Further Information)

Transmission Fluid Conditioner

Lubaid Conditioner for Automatic Transmissions, recently announced by Zecol-Lubaid, has been designed to prevent shrinking, hardening and cracking of automatic transmission seals.

Recommended by the manufacturer to be used as a preventative, to keep seals soft and pliable, it is also possible to use the new conditioner to stop minor leaks or seepage even after they have occurred. In addition, the conditioner contains an extreme pressure lubricant, which is said to reduce gear and bearing noise, and afford smoother, quieter shifting, with reduced wear on intricate parts.

It is guaranteed by the manufacturer to be harmless to automatic transmissions or fluid, non-foaming and non-corrosive to metals.

(Use Reply Card for Further Information)

Mechanic's Pal Wheel Step

Placed over the tire, the Mechanic's Pal Wheel Step, recently announced by the Bear Mfg. Co., puts the mechanic in a position to quickly install shims on alinement jobs or get a

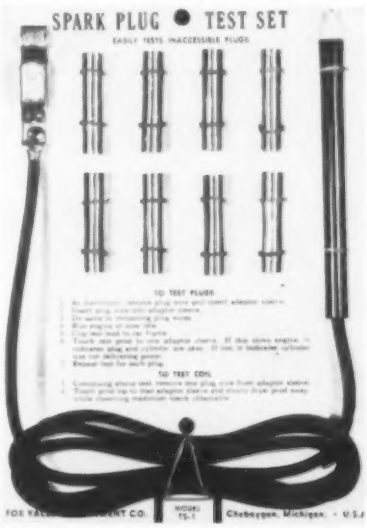
wrench in the hard-to-get-at spots under the hood.

The step is of especially designed all-steel construction to fit all tire sizes up through the 900's. Newly engineered "swing arms" allow easy placement under any fender and lock in place when weight is added to step. The locked swing arms, combined with strong teeth that grip treads firmly, prevents any slipping and sliding and does not harm tire treads in any way or mark sidewalls and wheel rings.

(Use Reply Card for Further Information)

Spark Plug Test Set

Now available is a spark plug test set consisting of eight adaptors which can be snapped quickly and easily into the distributor cap, plus test lead and prod, which make possible the old "screwdriver test" for faulty spark plugs and weak cylinders right at the distributor cap, even though the spark plugs be covered with insulators or inaccessible. According to the manufacturer, Fox Valley Instrument Co.,



this eliminates the need for puncturing high-tension insulators, as well as burned fingers. The set works on any battery or magneto ignition system and can also be used to test coils.

(Use Reply Card for Further Information)

Small, Foreign Car Battery

Production of a new wet or dry-charged battery designed especially for the small car and foreign car market, has been announced by The Electric Auto-Lite Co.

Featuring the exclusive design fea-

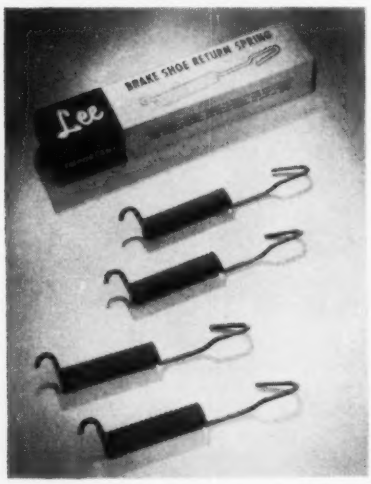
tures of Auto-Lite original equipment and replacement batteries, the new model is approximately 7 inches square and is said to exceed all service requirements of the Volkswagen (U.S.A. models 1955 through '58), Jaguars and XK-120 (1950-'54) and XK-140 (fixed head coupe 1955-'57), as well as the British-built MG (MGA-1956-'57) and German-made Opal (1957-'58).

(Use Reply Card for Further Information)

These are new *manufacturers' products*

Brake Shoe Return Springs

A complete line of packaged heavy-duty brake shoe return springs for all Bendix-type brakes is announced by the Lee Mfg. Co. These springs, made of heavy gauge spring wire, are



said to assure complete and full retraction of brake shoes away from the drum. These heavier springs are also said to help overcome pressure of the driver riding the brake pedal, causing lining to wear out prematurely and brakes to over-heat and fade; and in addition, the manufacturer states they also eliminate pulling and diving caused by heat-weakened return springs.

(Use Reply Card for Further Information)

Pre-Set Torque Tool

To facilitate accurate torquing in hard-to-reach places, The Milbar Corp. announces its Torque Tool, featuring a single setting and avail-

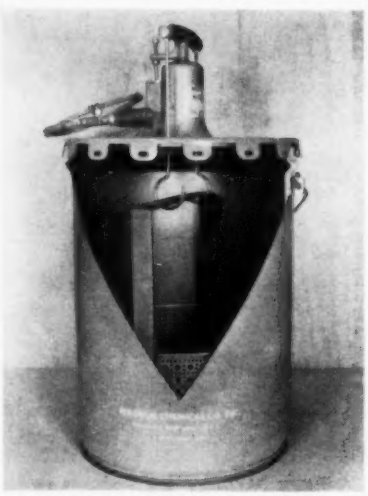
able in a wide range of torque settings. It is designed so that one end fits the square drive of standard sockets, while the other end fits the square drive of any ratchet or other hand wrench. When the threaded fastener which is being tightened has been drawn up to its predetermined torque, the release mechanism incorporated in the tool permits 5 degrees free rotation, instantly felt by the operator to signal that the maximum torque has been reached. Upon release, the tool automatically resets itself.

The tool is available in 3/8" or 1/2" drive in specified torques from 100 in.lbs. to 30 ft.lbs.

(Use Reply Card for Further Information)

Air Powered Parts Cleaner

A new bench type cleaning machine, with built-in air motor, which fits the top of any standard five, six or fifteen gallon open head container, is an-



nounced by Magnus Chemical Co., Inc.

After mounting unit to the container cover and connecting to air supply, a simple turn of the air valve automatically agitates the basket of parts up and down 100 times a minute through the Magnus cleaning solution —which is said to vigorously scrub the parts and shear the dirt from all metal surfaces, leaving them ready to rinse and use.

The Magnus Mini-Dip handles up to 50 lbs. of parts at a time, and is extremely useful for cleaning carburetors, fuel pumps, pistons, valves, and other small parts.

(Use Reply Card for Further Information)

Heavy-Duty Brake Fluid

The United Motors Service Division of General Motors is marketing a new economy-priced, heavy-duty brake fluid. Trade-named Delco Super 99, the new brake fluid has a minimum boiling point of 350° F. under operating conditions, and flows freely at minus-60° F., which exceeds SAE 70-R-1 heavy-duty requirements.

(Use Reply Card for Further Information)

Low Cost Air Hammer

A new low cost air hammer kit for removing the average muffler and tail pipe in just three minutes is announced by Superior Pneumatic & Mfg., Inc.

The kit consists of (1) a Superior

SP-700 air hammer, (2) a flat chisel, and (3) a muffler cutting tool. The SP-700 air hammer weighs just 3 1/2 lbs., measures 8" overall. It has a metering trigger that controls hammer blows from 0 to 2800 per minute so that semi-skilled help can easily do the job without damaging or distorting the pipes. A beehive type spring retainer holds the cutting tool so that the operator can easily rotate the hammer in any direction while it is still in use. Hammer operates on any standard service shop compressor.

(Use Reply Card for Further Information)

Brake Adjustment Tool

In answer to the increased problem of adjusting Bendix brakes on low slung '58 models, Herbrand Tools announces a new Bendix Brake Adjust-

ment tool. The specially designed curved end centers quickly on the adjusting star nut and the 9 3/4" over-all length of the tool is said to give proper leverage for an efficient job, without skinned or bruised knuckles.

(Use Reply Card for Further Information)

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No. 2. TROUBLE-SHOOTING INSTRUMENTS. Covering all important instruments, including oscilloscopes, used in connection with testing, diagnosis and tune-up operations. Each instrument is thoroughly covered individually to show how it works . . . how it is connected to get different readings . . . how these readings should be used . . . plus specific examples of problem solving.

No. 3. Ignition System Servicing

No. 3. IGNITION SYSTEM SERVICING. Explains the basic principles, theory and application of the primary and secondary circuits, breaker point and distributor operation, testing and servicing. Covers the function of the generator, coil, condenser and how they are related in the ignition system from battery to spark plugs. Detailed tuning and adjusting principles and service of magnetos.

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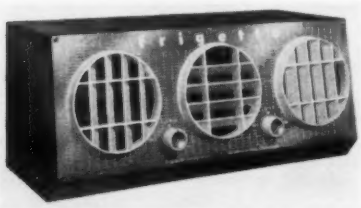
1A

These are new *manufacturers' products*

Air Conditioning Unit

Frigiquip Corp. announces that their latest under-the-dash auto air conditioning unit has been so improved over last year's models that its air moving ability has been increased 25 per cent; pumping efficiency of the



compressor is up 10 per cent, and installation is greatly simplified due to the elimination of unnecessary fittings and connections.

Compressor weight has been cut in half—from 32 lbs. to 16 lbs.—by making it almost all aluminum; yet capacity has been increased from 9.3 to 10 cu.in. displacement. The condenser has steel panels, top and bottom, as well as steel end-plates, thus affording complete protection to surface fins.

The evaporator case is all-steel with baked enamel finish. It has a brass front plate with satin chrome finish, and the unit is 15 9/16" long, 6⅝" high and 7¾" deep. A new temperature control is said to prevent coil icing.

(Use Reply Card for Further Information)

Tung-Sol Flashtester

A new flashlight auto lamp and fuse tester combination has been an-

nounced as a promotional item by Tung-Sol Electric Inc.

A built-in permanent Alnico magnet permits the heavy-duty flashlight combination to be mounted on any metal object; permitting "hands-free" work under the hood, beneath the car, behind the dashboard and in many other hard-to-reach spots.

Plastic-cushioned head and end caps, non-breakable lens and "floating" reflector make the Flashtester shockproof. Its square-shaped head prevents rolling and a weatherproof Durite barrel is resistant to oil and grease.

The easily-reached tester is designed to permit the unit to be used for on-the-spot checking of automotive lamp bulbs and fuses.

(Use Reply Card for Further Information)

Hood Holder

To hold hoods at their maximum opening and facilitate under-the-hood work, Peterson Mfg. Co. announces the Sparks Hood-Stick—a telescoping

adjustable strut with rubber-tipped forks on both ends to provide positive position and slip-proof protection.

Light in weight, and of all metal construction, the tool extends from 33" to 60". A positive, self-locking ball lock keeps tool from slipping when in use.

(Use Reply Card for Further Information)

Ball Joint Suspension Grease

As a quick answer to the problem of noisy, creaking front suspension ball joints Amalie Division of L. Sonneborn Sons, Inc., announces a new Black Velvet Ball Joint Suspension Grease, formulated from a heavy-duty, highly water-resistant chassis lubricant, fortified with graphite and other load-carrying and corrosion-resistant additives. It is said to have unusual tenacity, endurance and strength, to assure prolonged and effective lubrication of the heavily stressed and loaded bearing surfaces characteristic of all types of ball joint and torsion bar suspensions.

(Use Reply Card for Further Information)

Volt-Amp Tester

The King Electric Equipment Co. announces a new economy model Volt-Amp Resistance Tester for testing and adjusting automotive generators and regulators.

It is stated that meter scale range covers both 6 and 12 volt systems and that provision is made to read generator outputs up to 80 amperes. A special low reading (0-2 volts) scale is said to provide for detecting electrical losses in the vehicle wiring and to make possible individual cell testing of vehicle batteries. The manufacturer claims that better than 1% testing accuracy is obtained through the use of a large jeweled D'Arsonval meter.

(Use Reply Card for Further Information)

Plastic Body Solder

Instead of two liquid hardeners, Plasto-Bond Metal Mender, a product of Swiss Laboratory, now comes with a one-tube cream hardener, which is said to not only eliminate the waste, muss, fuss and spillage common with liquids, but in addition offer three-speed control of fast, medium and slow hardening. Moreover, it is said to go on smoother with no-drag, and without leaving pin-holes.

(Use Reply Card for Further Information)

Permatex Has Spreader Cap

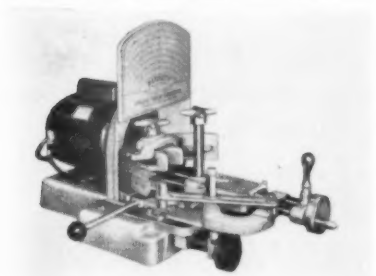
Flexible tubes of Permatex Form-A-Gasket, heavy duty automotive sealant, are now packaged with a special

spreader cap which is said to give the shopman improved control of sealant application while preventing messy fingers. The new package, which replaces the former fiber can, enables the user to save storage space and permits greater ease in handling and displaying the product.

(Use Reply Card for Further Information)

Radius Grinder Improved

Announcement has been made by the Barrett Equipment Co. that their B-75B Radius Grinder now includes



an anchor eye shoe positioner as standard equipment. With the shoe positioner one can grind brake shoes to "eye" for anchor hole position.

The grinder is also being preset at the factory to automatically undersize grind brake shoes to properly fit the brake drums into which they are to operate.

(Use Reply Card for Further Information)

Arco Introduces New Solvent

Arcosol, a new solvent for lacquer, enamel and acrylic finishes, recently introduced by The Arco Co., is said to be so effective that all types of automotive finishes can be reduced to spraying consistency with approximately half the amount of solvent normally required. This not only assures better solvency to the entire drying period but gives better flow and adhesion to any surface.

Another important advantage claimed is that Arcosol increases depth of color and gloss in the finished coat because more solid paint can be applied in one coat. According to the manufacturer, sand scratches will not show through and heavier coats may be sprayed without causing runs and sags.

(Use Reply Card for Further Information)

Oil Packaged in 2.5 Liter Cans

To solve the annoying problem of opening three U.S. quart cans of oil to obtain the proper amount of oil when filling the crankcases of small imported cars, and having a substantial amount of oil left over in the third can, White & Bagley Co. is now marketing its Oilzum in 2.5 liter cans —the exact measure for crankcases of Volkswagens, Dauphines, and others.

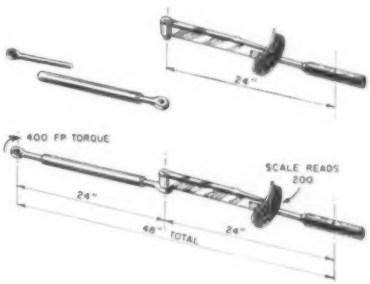
Oilzum, said to be a longtime favorite of automobile racers, (most used over the years in the Indianapolis "500," for example) will continue to be marketed in containers ranging from one-quart cans to 55-gallon drums, in addition to all grades in the new size can.

(Use Reply Card for Further Information)

Torque-Wrench Extensions

With the new torque wrench extensions being manufactured by the Owatonna Tool Co., an OTC torque wrench can handle up to twice its rated capacity without pulling any harder on the handle.

The new OTC extensions are made



up of two pieces: A tubular steel adapter arm with a square opening to fit the torque-wrench drive and one of the many drive-end accessories—box wrenches, 15° and double-offset wrenches, ratchet and fixed ¾", 1" and 1½" drives.

No complex figuring is needed when using the OTC extension. Because exerted torque is doubled, the dial reading is simply multiplied by two.

(Use Reply Card for Further Information)

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Automotive Clinic . . .

(Continued from page 6)

poor condition or of the wrong heat range, breaker points in poor condition, cross firing in the distributor or HT wiring, automatic or vacuum advance not performing properly, excessive valve tappet clearance, incorrect dwell, etc.

About the carburetor, it might help to install a new one, especially if the present one is not original equipment.

Noisy Steering Wheel?

On a 1958 Dodge Coronet we are experiencing a noise that sounds like marbles rattling in the steering wheel when crossing railroad tracks or rough roads. Have checked for loose steering linkage and bearing under steering wheel, but to no avail.—*C.E.L., Chillicothe, Ohio.*

Answer: Noises in automobiles can be very confusing. They are often telegraphed from the actual source to where you hear them.

Try having someone else ride with you, sitting in different locations of the car, listening for the noise. In this way you can often locate the point from where the noise originates, so that the needed correction can be made.

Check under the dash, in the glove compartment, on the fire wall, etc., for a loose wire, loose screw, or loose part. Check inside the doors, check the window regulator and door locks. Heard of a recent case where a noise sounded as if the left hand door lock was loose and rattling, but it proved to be coming from the trunk lock where there was a loose link.

Rear Bearing Failure

Perhaps you can help us settle a controversy we are having over an overhaul job on a customer's Ford 332 truck engine.

The truck was thoroughly checked for oil leaks, etc. while heads, tappets, etc. were checked and adjusted. We also road checked the job and found no indication of oil leaks.

The truck was put in service with a load immediately after the overhaul and was driven approximately ninety miles, after which the rear main bearing seal showed a bad leak.

We immediately took the rear main down and found the main had turned in the block, ruining the engine. At the time of overhaul we had the main journals turned in our jobber's shop to .010″ undersize; and the same shop furnished us with the new main bearings.

Upon miking the shaft, after it was removed, we found the rear main journal to be 2.615″. Three other mechanics miked the shaft with their own mikes: Two got a reading of 2.615″, the third a reading of 2.61475″. The rear main is slightly larger than the other four. In our book, standard size for this shaft is 2.6230″-2.6238″. The rest of the main and rod bearings are perfect. All bolts were accurately torqued to proper specs.

Now we maintain the shaft, being too large, ruined the block; the machine shop claims that it could not. What do you think?—*L.A.C., Huron, S.D.*

Answer: According to the figures given, the rear main journal was turned down only .008″ instead of .010″. If the same size undersize bearing was used, it is possible that the .002″ decrease in oil clearance space between bearing and journal could cause insufficient lubrication at this bearing and cause it to seize on the shaft.

We don't understand what could have happened to ruin the engine, as you stated. If the bearing seat in the rear main bearing bore is damaged, this can be cleaned up and shimmed. You don't say how long the engine was run before letting it go out on the road, or how fast it was driven

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on the 90 mile trip; whether the oil pressure was checked, or the temperature noted.

The oil leak could come from high temperature at the rear bearing when it started to fail. However, with the information submitted to us, we cannot comment further on this job.

Ford Timing Marks

Could you please inform me if there is any change in the initial ignition firing point in the Ford-Mercury cars from '49 through '53. What I mean is, regardless of anything to do with fit, or belt size, could any crankshaft pulley be fitted to say a 1952 Mercury engine and the timing mark used to put this engine in proper time, regardless of whether the pulley was off a Ford or Mercury car or truck from '49 to '53?—*F.M., South Burnaby, B.C. Canada.*

Answer: The 1949-'53 Ford engines had 2°BTDC ignition timing, while the 6-cylinder engines were timed at TDC. On the Mercury for the same years, the recommended timing is 2°BTDC but the pulley on the '49 has the mark at 4°BTDC, the '50, '51 and '52 is at 2°BTDC, while the '53 is at TDC.

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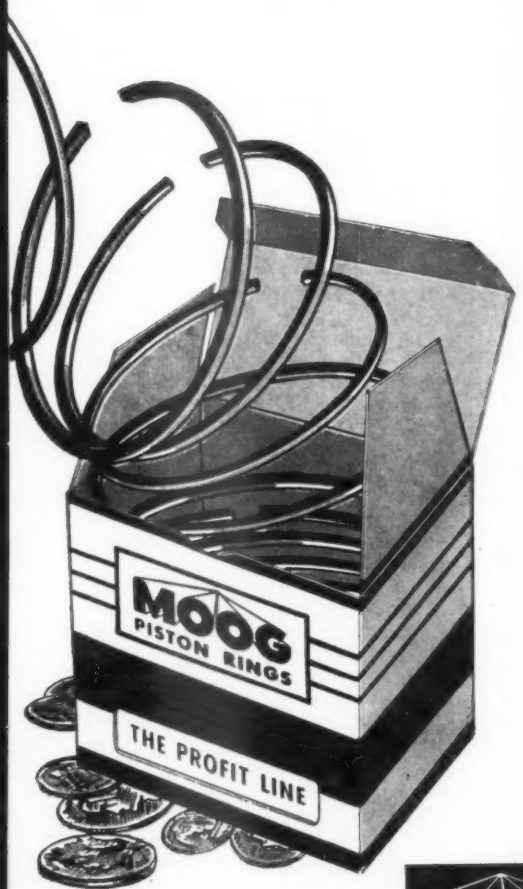

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CHROME OYL "EXTRA SERVICE"
An improved set with chrome plated steel segments and new design cast iron spacer for extra service, maximum oil control.

EXCLUSIVE "CHROME PLUS"
With revolutionary "break-in sheath." Seats fast as cast iron, with wear of hard chrome. Chrome top rings and Chrome Oyl steel segments. Outperforms any ring on the market!

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Hard Starting Caddy

I am having starting trouble with a customer's 1953 Cadillac. After this car has stood idle for 24 hours or more the engine will start and run for a few seconds; then it dies, and is very hard to get started again.

I have checked for flooding, but there is no indication of this condition. Installed new ignition points, plugs, coil and condenser; cleaned carburetor, installed new gaskets, checked fuel pump and adjusted automatic choke to factory specs.

Just what have I been overlooking on this job?—*E.T., Ste. Genevieve, Mo.*

Answer: From your description, the trouble is in either the fuel or ignition system. Check for air leaks in the suction side of the pump line, particularly the flexible line. Remove the air cleaner and observe the action of the automatic choke. Put an exhaust analyzer on the car and check for idle mixture and running mixture.

In the electrical end, check for voltage drops in the ignition system, in the starter circuit. Be sure there is a perfect ground from battery to car frame. Check the cam angle or dwell, which should be 26°-33°. This car is the first of the 12-volt Cadillacs, and it is possible that the series resistor in the ignition system is not acting as it should.

If you will make careful instrument tests you should be able to locate the source of the trouble. Remember, if you have normal ignition, compression, and carburetion, the engine will start and run.

Noisy Transmission

What would cause the 3-speed transmission of a 1950, ¾-ton Chevrolet truck to clash gears when shifted into high? We just took this truck in on a trade and have not had the transmission out, as yet. Have adjusted the clutch and slowed down engine idle. It will shift okeh if the driver double clutches it.—*A.N.E., Green Lake, Wis.*

Answer: It is probable that the synchronizing clutches are worn, which allows the gears to spin instead of being held to synchro speed by the clutches. On this eight year old truck it is likely that some new parts are needed, unless whoever drives it is willing to double clutch when shifting.

To make your shop more profitable . . . your time more valuable . . . be sure to read this month's "These Are New" section

Clearing Up A Few Facts About Spark Plug Life

• TO CLARIFY a few misconceptions regarding spark plug service and performance, the Champion Spark Plug Co. offers the following spark plug facts:

Misconception: *A hot spark plug gives a "hotter" spark.*

Fact: There is no connection between heat range and intensity of spark. The term "hot" plug or "cold" plug refers only to the relative operating temperature of the insulator firing end. On a "hot" plug, a long insulator nose tends to retain heat, so that the plug actually runs hotter. Such a plug will help to burn away fouling deposits in an engine which is burning oil or operating under light service conditions.

A "cold" plug has a short insulator nose which dissipates the heat more quickly. This is important when operating heavy loads, or in high speed operation, since it helps eliminate overheating of the plug and possible pre-ignition.

Misconception: *Abrasive cleaning of spark plugs removes the protective glaze.*

Fact: Abrasive cleaning, properly done with a good spark plug service unit, removes only the foreign deposit. It will not harm the plug. Glaze has not been used on the firing ends of spark plugs since the early 20's, when leaded fuels were introduced. The temperature of the firing tip is the main factor which determines how fast deposits will accumulate.

Misconception: *Premium fuels cause spark plug fouling.*

Fact: Long periods of slow city driving or idling are usually the cause of deposits on spark plugs which cause shorting and misfire. The reason that the new high powered engines have to have the plugs cleaned more frequently is that they use proportionately less of their available power at low rpm, thus tending to run the plugs too cold at low speeds. The new projected core nose type spark plugs help to eliminate the type of fouling.

The best ways to minimize fouling, once the proper type of plug and heat range are used are (1) "exercise" the engine on the highway occasionally with short, gradual increases in speed to raise combustion chamber temperatures. (2) Use the proper grade of fuel in the engine. (3) Have the plugs cleaned at least every 5,000 miles.

Misconception: *When testing the spark plugs in the comparator on a service unit, they should fire up to a pressure corresponding with the engine compression.*

Fact: Engine compression has no direct relation to the quench pressure in a bench test, since other variables offset this factor. These variables include: (1) a plug with a wider gap will quench at lower air pressure. (2) the voltage output of the tester might be low. (3) line voltage to tester may be down (such as when an air compressor is running, etc.) For such reasons, spark testing of plugs at arbitrary air pressures can be misleading. To eliminate the effect of these variables, determine the point of "100% sparking efficiency" with a new plug of the same type and gap as the old plug. Then set the movable dial of the comparator to this point. Relative efficiency of the used plug can then be measured against this norm. Also, never try to check a plug until it has been properly cleaned, filed and the gap set.

Misconception: *The "ribs" on the insulator of the spark plug are for cooling.*

Fact: These ribs are to make it more difficult for the current to "flashover" the plug when it is wet or dirty.

The heart of any tune-up*
*Shurhit Assembled Contact Set and Condenser
As any mechanic knows — never replace just the points — replace both points and condenser.
Shurhit Assembled Contact Sets will save you installation time because they are completely adjusted at the factory. They are matched, mated and balanced sets. Condensers are of 100% waterproof construction with connector plate WELDED to the lead. Shurhit Products are the acme of perfection, backed by a written guarantee that protects YOU and your customers. On your next tune-up job, try Shurhit and you'll agree it's the World's FINEST Ignition.
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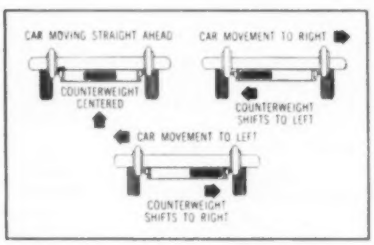
Waukegan, Illinois
WORLD'S FINEST IGNITION

Since electricity always follows the path of least resistance, it would be easier to follow the electrode down the center of the plug than to travel over the ribs on the insulator. Thus, these ribs help to keep the current inside the plug where it belongs, firing the engine properly. The same principle, incidentally, is used on the insulators which you have probably seen on high voltage power lines.

California Firm Introduces New Car-Stabilizer Unit

Representatives of the automotive field, police and sheriff offices, safety organizations and the military, recently witnessed a demonstration of "Safety Control," a new stabilizer now being marketed by International Precision Manufacturers of Carmel, Calif. According to the firm, which points out that 80% of accidents are caused by skids or blowouts, expert drivers were unable to put any of four different models—two sports cars, a station wagon, a stock 4-door sedan—equipped with Safety Control, into a



Operating principle of stabilizer unit.

side-slip or roll-over, even at about 75 mph under simulated hazardous road conditions.

Operating on a basic principle of physics—every action is accompanied by an equal and opposite reaction—the device applies a counter force to a swerving car. It is 32" long, 4½" square in cross section; weighs 60 pounds; is attached within the trunk or on the rear cross-member. The maker claims it stabilizes the car constantly, gives the driver firm control even in cases of blowout, increases braking efficiency up to 22%, improves traction, and makes possible safe panic stops or turns when necessary.

Hitting slick "Foamite" at 70, driver Red Geesman brings TR-3 to smooth panic stop, no-hands, in demonstrating new "Safety Control" device at Fort Ord, Calif.

Plastic Lamp Lenses Damaged by Gasoline

When plastic lamp lenses on the rear of late model automobiles are repeatedly subjected to gasoline, either by splash or wiping with gasoline saturated rags, damage will occur. If gasoline accidentally contacts the lenses, the affected area should immediately be thoroughly "washed down" with clear water.

Revise Front End Specs On Chevy's Level Air Cars

On 1958 Chevrolet passenger cars equipped with Level Air Suspension, the front end alignment specifications have been revised. The correct alignment specifications are:

	Level Air	Coil
Caster	$1\frac{1}{2}° \pm 1/2°$	$0 \pm 1/2°$
Camber	$1/2° \pm 1/2°$	$\frac{1}{2}° \pm \frac{1}{2}°$
Toe-In	$0" — \frac{1}{8}"$	$\frac{1}{8}" — \frac{1}{4}"$

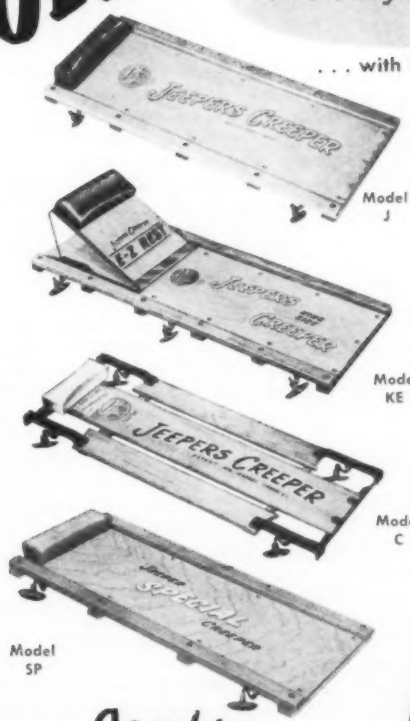
DURABLE

Comfortable

JEEPERS CREEPERS

. . . easy rolling

. . . with FAMOUS RALCO ROLLERS*



Unmatched for performance and value, these creepers, available in an eleven-model range of types, sizes and prices, are all designed for long, comfortable service and made of the finest, kiln-dried hardwood.

Jeepers Creepers are low-slung, easy to maneuver and fitted with soft, plastic-coated headrests that are resistant to acid, grease, gas and alcohol.

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ASK YOUR JOBBER

Literature:

manuals, catalogs and charts

most items are yours for the asking

TURNSIGNAL FLASHERS . . . In addition to showing both the dealer and suggested retail prices of automotive flashers used on all automobiles manufactured since 1946, this latest 1-page flasher specification chart and price list includes necessary working specifications, application notes, outline drawings and physical dimensions.

Write to: Tung-Sol Electric, Inc., Dept. ASD, 95 Eighth Ave., Newark 4, N.J.

VAPOR LOCK . . . New two color illustrated bulletin, entitled "Your Answer to Vapor Lock," explains in detail causes of vapor lock and how Filt-O-Reg fuel pressure regulator is said to prevent the occurrence of vapor lock and give quicker hot-motor restarts.

Write to: Alondra Sales, Inc., 959 Crenshaw Blvd., Dept. ASD, Los Angeles 19, Calif.

BODY REPAIR PANELS . . . More than 600 tailor-made autobody repair panels for all American cars from 1947 to 1958 are listed in this latest catalog. Well illustrated and arranged alphabetically by automobile make, year and model, it is possible for the bodyman to find the panels needed for the job in a matter of seconds.

Write to: Schofield Manufacturing Co., Dept. ASD, 1140 E. 222nd St., Cleveland 14, Ohio.

BRAKE SERVICE . . . The 12th edition of the Grey-Rock Brake Service Manual is a 60-page book illustrating every type of brake system and giving complete brake adjustment and relining instructions for all makes of cars, and all types of truck, trailer and bus brakes, including 1958 models. It also gives complete "trouble shooting" information on hydraulic, air and vacuum brake systems.

Components of air, hydraulic and vacuum systems are fully illustrated and their operation described. Power brake systems are shown with description of operation, together with hook-up of air brake system complying with I.C.C. regulations for tractor-semi-trailer rigs.

The manual is priced at $3.00, and is available from the Grey-Rock Division, Raybestos-Manhattan, Inc., Dept. ASD, Manheim, Pa.

TIRE RETREADING . . . A set of seven bulletins explains and illustrates channeling; improper buffing; poor molding; radial cracking of sidewalls; tread tearing; tread separation and groove cracking—the most common causes of retread failures.

Write to: The Rubber Manufacturers Association, Inc., Dept. ASD, 444 Madison Ave., New York, N.Y.

STEEL SHELVING . . . 8-page, 2-color booklet describes and illustrates six styles of open and closed types of plain and ledge shelving, drawer units, counters, tool inserts and shelving boxes. Also given are complete dimensional tables and planning diagrams.

Write to: Penco Metal Products Div., Allan Wood Steel Co., Dept. ASD, 200 Brower Ave., Oaks, Pa.

TIRE GUIDE . . . Contained in this 80-page pocket-size manual are: tire sizes and proper air pressures—front and rear—for all American passenger cars from 1942-'58 and all popular foreign car models; complete passenger and truck tire comparison charts; up-to-date price lists on passenger and truck retreading; and easy-to-use master tire discount tables.

The guide sells for $2.00 per copy, and can be ordered from Elgar Co., 2 East 23 St., Dept. ASD, New York 10, N.Y.

BEARING FAILURES . . . All of the causes, effects and cures of engine bearing failures, as well as over-all diagnoses of engine troubles, are clearly illustrated on a new wall chart designed especially for automotive repair shops by the makers of Monmouth engine bearings.

Write to: Cleveland Graphite Bronze Co., Division of Clevite Corp., Cleveland 10, Ohio.

MACHINE TOOLS . . . 80-page catalog illustrates and describes entire line of South Bend precision machine tools, including: engine lathes, toolroom lathes, turret lathes, vertical spindle milling machines, bench shapers, drill presses and pedestal tool grinders. Attachments, tools, chucks and accessories for all of the company's machine tools are also listed, as well as capacities, floor space requirements and shipping weights.

Write to: South Bend Lathe Works, Dept. ASD, South Bend 22, Ind.

HAND TOOLS . . . 60-page catalog contains up-to-the-minute listing of mechanic's hand tools. Ready-punched for any style binder, it includes complete descriptions and illustrations for each item and is illustrated with over 400 photographs and drawings.

Send 25c for Tool Catalog 56 to Herbrand Division, The Bingham-Herbrand Corp., Dept. ASD, Fremont, Ohio. This will also place your name on their regular monthly mailing list.

BONDED BRAKE SHOES . . . Application data covering Thermoid's entire bonded brake shoe line are contained in a newly released catalog featuring: (1) a complete alphabetical listing of all popular passenger cars and light trucks; (2) a numerical listing of lining sizes and drum diameters keyed to a new brake shoe identification chart section; (3) forty-two drawings of brake shoes giving correct lining position as well as drum diameters, the set number and the segments to be used in bonding these shoes; and (4) illustrations and data covering Chrysler emergency brake bands.

Write to: Thermoid Company, Trenton, N. J.

LUBE EQUIPMENT . . . Two new catalogs for automotive lubrication equipment users are yours for the asking. Catalog #103 contains all the lube equipment necessary for completely equipping a modern automotive service department, with diagrams illustrating the simplicity of installation. Catalog #203 includes service department accessories and supplies.

Write to: Gray Co., Inc., 1012 Sibley St., N.E., Minneapolis 13, Minn.

You may want this information and most of it comes to you free. Just write to the name which appears following the listing and your request will get prompt attention. To be sure of getting the item you want mention that it is the one listed in AUTOMOTIVE SERVICE DIGEST.

LIFTING 1958 CARS . . . Handy wall chart shows exactly how to use a one-end lift on all makes of 1958 cars. Large, clear, illustrations show each make of car separately, together with easy-to-understand instructions for lifting at front or rear.

Write to: Blackhawk Mfg. Co., Dept. ASD, Milwaukee 46, Wis.

BRAKE PARTS . . . 96-page catalog covers complete line of hydraulic brake parts, cylinders, kits, hoses, switches and fluid. In addition to the usual information on master and wheel cylinder assemblies, repair kits, and hoses, the application section includes wheel cylinder cup specifications. Catalog also contains additional information and cross references such as sections on cylinder component parts, kit contents, parts illustrations, buyers guides, numerical listings, information on tools, fluid, assortments and complete interchanges.

Write to: Lisle Corporation, Brake Division, Dept. ASD, 807 Main St., Clarinda, Iowa.

TIRE VALVE CHART . . . 10" x 24" wall chart lists proper value for tubeless tire applications for 27 models of 21 different cars. For each model, according to the year and corresponding tire size, the chart prescribes the proper snap-in or clamp-in valve, plus extensions, where required.

Write to: Dill Mfg. Co., Dept. ASD, 700 E. 82nd St., Cleveland 3, Ohio.

SHOCK ABSORBERS . . . *"The Service Story on Shock Absorbers"* points out the need for shock absorber service on many cars on the road today. It illustrates proper servicing methods, including the importance of regular inspection of shock absorbers on air suspension cars.

Write to: United Motors Service Division, Dept. ASD, Detroit, Mich.

TEST EQUIPMENT . . . Colorful, easy-to-read, envelope-size folders contain valuable information on basic automotive testing equipment.

Write to: Harvey E. Hanson Co., Dept. ASD, Lake Blvd., at Commercial St., Paw Paw, Mich.

1958 AEA CATALOG . . . The 1958 AEA Electrical and Fuel Systems Catalog provides a ready reference covering all popular fast-moving parts for distributors, generators, starting motors, carburetors, fuel pumps, fuel gauges and fuel lines for all passenger cars and light trucks. All units and parts shown are original equipment for the vehicle listed. The catalog also includes an illustrated section as an aid to help identify the various parts listed. A complete price list of all parts listed is also included in each catalog.

Write to: Automotive Electric Association, Dept. ASD, Detroit, Mich.

BRAKE CHART . . . A quick reference chart for MoPar's total contact brakes is available for use in shops as an aid in identifying and ordering brake system parts and service packages.

Write to: MoPar Division, Chrysler Motors Corp., Dept. ASD, Detroit 31, Michigan.

Calendar of Automotive Events

1958

June 25-29—IGO-America 1958 Convention, Statler Hotel, Los Angeles, Calif.

Aug. 13-17—"Rod & Custom World's Fair" Auto Show, Eastern States Exposition Fairgrounds, West Springfield, Mass.

August 27-30—Automotive Parts Rebuilders Assn., National Convention and Trade Show, Conrad Hilton Hotel, Chicago, Ill.

Oct. 15-18—National Glass Dealers Assn., 1958 Convention, Americana Hotel, Miami Beach, Fla.

Dec. 12-16—Automotive Warehouse Distributors Assn., Inc., National Convention, Muehlebach Hotel, Kansas City, Mo.

1959

Jan. 17-25—Chicago Automobile Show, International Amphitheatre, Chicago, Ill.

Jan. 31-Feb. 4—National Automobile Dealers Assn. Convention and Equipment Exhibition, Conrad-Hilton Hotel, Chicago, Ill.

Feb. 15-17—Automotive Affiliated Representatives Meetings, Pick-Congress Hotel, Chicago, Ill.

Feb. 18-21—Automotive Service Industries Show, Navy Pier, Chicago, Ill.

America's 80 million licensed drivers drove a record-breaking 650 billion miles last year, or 320 billion more than in 1947. The American Finance Conference points out the 1957 mileage total was equivalent to about 1¼ million round trips to the moon.

MANY MAKE OVER $10,000 A YEAR! "After 3 months we are doing $850 per mo. in radiator work and increasing all the time"—Robbins Motor Co., Marlow, Okla. "Now going at rate of $18,000 a year," says Clough, Storm Lake, Ia. You, too, can do this well!

20,000,000 Radiators Need Servicing Yearly! And with today's engine power increased, cooling capacity decreased, radiators will require more service than ever! Get your share of this huge profit potential—now!

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BY _____ TITLE _____
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Are you now operating a radiator dept.? ☐ Yes ☐ No

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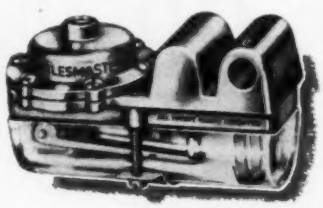
FUEL PRESSURE REGULATOR



You can get more dollars out of every engine tune-up . . . and make your customers happier, too . . . by installing a genuine Milesmaster Fuel Pressure Regulator. Makes every engine run better, smoother, saves gas. One model fits all vehicles.

ONLY $6.95 LIST

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Chicago 2, Illinois • DEPT. R

Imperial Educational Film Shows How to Work Tubing

A 20-minute color movie showing some of the hazards encountered in tubing installations and how to avoid them, has been produced by The Imperial Brass Mfg. Co. The film demonstrates the correct way of handling tube cutting, flaring and bending operations.

The movie is currently being presented at sales meetings with Imperial distributors and also is being used at Tubemanship Clinics being held by distributors with industrial plants, and trade schools.

One of the purposes of the film is to highlight installation methods that save time and prevent trouble on tubing jobs.

New Kal-Equip Plant To House All Facilities

Lee Parmater, president of Kal-Equip Co., recently announced that all company manufacturing, engineering, service and administrative departments have moved into a new plant at Otsego, Mich.

Since its inception, only three years ago, the firm has undergone expansion of facilities twice before, always remaining in Kalamazoo. Now, with the building of an all new plant designed to house the present operations and to provide for future expansion, the company has moved permanently to Otsego.

A Helpful Tip When Timing The 332 cu. in. Ford Engine

Many 1958 Ford 332 cu.in. engines have come from the factory with yellow paint marks on the vibration damper. These are placed there only for production and assembly purposes.

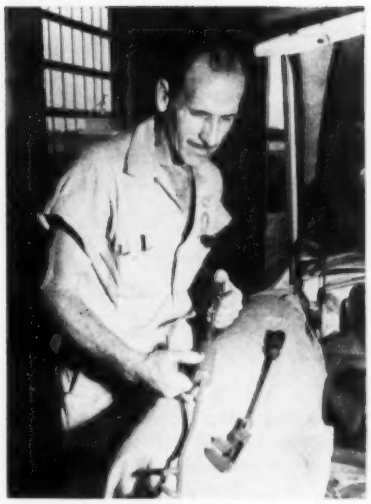
Be sure, when timing these engines, to use the regular marks, *scribed* on the vibration damper.

Mechanic Designs Adjuster For "Hot" Distributors

Adjusting a distributor at the rear of a really hot V-8 is a man-sized job; and mechanics do it every day in connection with tune-up—but they don't like it. So when Ed Williams, mechanic with Miracle Mile Motors at Delray, Fla., decided he had had enough, he did something about it.

The illustration shows Ed with two distributor adjustors of his own design. The one that he is demonstrating has a slide hammer effect. It's just a length of ⅜" rod with a double hook at the end.

With his timing light hooked up and the distributor loosened just enough so that it can be turned, Ed goes into action with this adjuster. Slipping the end of this piece of equipment over the distributor arm, he gently bumps the distributor one way or the other—possibly because of the double hooks—until the timing is just right.



Ed Williams

The distributor adjuster lying on the fender is sort of a screw clamp with a long handle. It was made from some strap iron about ⅛" thick by an inch wide. There's a nut brazed to a sliding piece of strap iron so that the threaded end of the long handle can be turned to make the clamp open or close.

When it clamps onto any projecting part of the distributor it is possible to make the fine distributor adjustment that is necessary to give the finishing touch to a good tune-up job.

"My card, Sir! I'm with the Hold-Tite Gasket Cement Co.!"

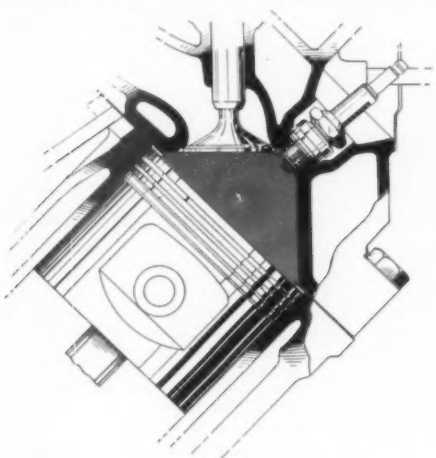
BRUSHING UP ON THOSE

EASY-TO-FORGET THINGS

Refresher course

The meaning of energy . . . working and potential

• IN GENERAL, the term energy may be defined as capacity for doing work. Consider, for example, a pile driver the heavy weight of which is lifted and allowed to drop on a pile for driving it into the ground. Work is done in lifting the weight and as a result the weight can do work, that is, drive the pile. This capacity of the weight in an elevated position to perform work is called—*energy*. The energy could be increased by using a heavier weight or by lifting it to a greater height.



Potential energy exists in the, previously-compressed, ignited fuel charge (shown in color) which forces the piston into the cylinder. The energy is gradually spent as the piston nears its lowest point on the power stroke.

Water rushing from a water wheel nozzle has capacity for doing work due to its rapid motion, and thus has energy. The greater the quantity of water and the more rapid its flow the greater the amount of energy.

When a clock spring is wound, it drives the clock as it unwinds because of the elastic strain within it due to its change in shape. The energy that a body has due to its position or state of strain is called—*potential energy*. The energy of the raised pile-driver weight is potential. Also, the energy of the hot, compressed gases, immediately following ignition in the cylinders of an engine is—potential energy. It is the energy that pushes the pistons, and by way of the connecting rods, to rotate the crankshaft, propeller shaft and ultimately impart forward or backward motion to the motor vehicle.

Promote Your LEADER Cars with Revolving Multi-Color FLASHES

TRIPPE LEADER LIGHT

Mount on hood or roof of car by its suction cup base or hang from post!

60 COLOR CHANGES EVERY MINUTE

They won't pass you by if you catch their eye with this fascinating attention getter!

Nothing like it! No installation necessary. Ready to operate the minute you plug it in. Use indoors and outside . . . completely weather-proof! Can increase traffic 25% the first day. Simply press suction cup on car roof—or mount in showroom window or in car lot.

Don't Delay! Get the Facts!

TRIPPE MFG. CO.

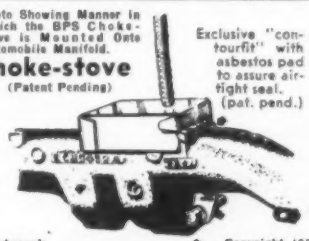
Dept. E-5—133 N. Jefferson St., Chicago 6

Photo Showing Manner in Which the BPS Choke-Stove is Mounted Onto Automobile Manifold.

choke-stove

(Patent Pending)

Exclusive "contourfit" with asbestos pad to assure air-tight seal. (pat. pend.)



Trademark Copyright 1957

Choke-Stove mounting strap. (Uses one manifold bolt.) No holes to drill.

STOP CARBURETOR TROUBLE ON FORD, LINCOLN, MERC., OLDS., CHEV. AND CHRYSLER PRODUCTS!

Fits all 1955-1957 Ford Products, 1957-58 Chevrolet, 1956-58 Oldsmobile, Chrysler, DeSoto, Dodge, Plymouth, Imperial—All models 1955-57.

Have our complete line of choke-stove kits in stock for **you will** have calls for them.

Even when the above tube is new and good it gives trouble. This tube is engineered to heat up choke-housing very quickly, but on a hot day or long pull the air passing thru this pipe gets too hot and causes gasoline in carburetor bowl to boil, making excessive gasoline fumes and hard starting—particularly the Olds.

FULLY GUARANTEED $5.95 LIST

Eliminates . . .

• Sticking choke • Plugged air passages • Wasted gas • Complete carburetor failure

Send name, address of your jobber. Specify make, model and year of car when ordering.

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IT TAKES TIME and PERSEVERANCE TO BUILD GOOD CUSTOMER RELATIONS!

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Thousands of Brake and Service Operators Throughout the Country are Using . . .

TRU-TORQUE

Safety Cups for Wheel Cylinders . . .

as one of their principal tools to insure good, trouble-free functioning of the hydraulic system on their brake jobs.

Operators have learned that they can depend on TRU-TORQUE to insure *perfect functioning* of the hidden parts in wheel cylinders throughout the life of their brake jobs.

Ask your jobber about our economical cabinet assortment!

TRU-TORQUE

1200 RECO AVE • ST. LOUIS 22, MO.

To Adjust Tappets on '58 Plymouth Six Removal of Fender Shield is Necessary

According to a recent Plymouth Service Bulletin, the opening in the right-hand fender shield used for servicing 6-cylinder engine valve tappets was discontinued in the '58 models, which makes it necessary to remove the right front fender shield when servicing valve tappets.

The following procedure for removal and installation of the shield is recommended:

- Protect the front edge of the right door with 2″ or 3″ masking tape applied from the bottom upward to a point approximately 4″ above top of right fender. Also apply tape along the rear edge of fender and lower edge of wheel opening.
- Remove the bolts securing fender side shield to fender, body, frame and grille in following order: bolts in door opening (2); fender to lower body bracket (1); fender shield to frame (1); rear of fender shield to body (3); fender to shield brace, located at top rear of wheel opening (1); shield to top edge of fender, accessible from engine compartment (4); bolts inside wheel housing securing shield to grille and fender (7) and fender to dash panel bolt at upper rear corner of fender (1).
- Obtain clearance for removing side shield by pulling lower corner of fender outward, and support fender with a 9″ block of wood.
- Adjust tappets and reinstall fender side shield by reversing the above procedure. To assist in reassembly, partially install the bolt used to secure fender shield to frame.

TAKE UP SLACK TIME—MAKE EXTRA MONEY FIX SMALL AIR COOLED ENGINES

New—Third Edition Now Available

GET THE SMALL ENGINES SERVICE MANUAL Edited by Engineers and Professional Mechanics CONTAINS: 22 makes, 5 more than in 2nd Edition, including Lawn Boy, Lycoming and the famous Italian Vespa Scooter engine. Also British J.A.P.

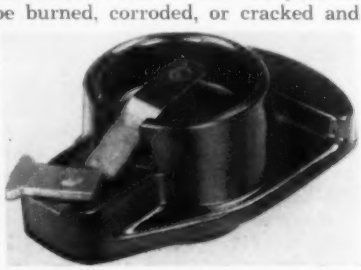
NEW AUTHORITATIVE SECTIONS COVER: Gas Engine Fundamentals, troubleshooting and servicing of ignition and carburetor equipment . . . plus . . . A SECTION ON TROUBLESHOOTING FOR BEGINNERS.

246 pages of practical down-to-earth information on 2 and 4 cycle engines, 1, 2, and 4 cylinder models. Parts information on more than 17,000 items Fits and clearances . . . oversizes and undersizes . . . addresses of Parts Distributors. . . . Tool requirements. Order now. Price $4.65. Satisfaction guaranteed or your money back. Send check or money order. Clip this.

SMALL ENGINES SERVICE MANUAL 1014 Wyandotte Street, Dept. K-1, Kansas City 5, Mo.

It Could Happen to You

When performing a tune-up on a customer's car, it is possible for a distributor rotor to mislead you. In some cases it can be burned, corroded, or cracked and still continue to deliver some sort of a spark.



Shown here is a rotor taken from a car on which the shopman was trying to locate the cause of late timing. It's an unusual case, but you'll notice the insulator had broken, allowing the top segment to rotate slightly on its mounting rivet. Also note that one corner is burned, indicating severe arcing—but the car still ran.

So don't overlook the rotor on tune-ups. Examine them closely for defects and wear, and replace when in doubt. Always keep in mind—An ignition system is only as good as its weakest point.

Says both motorist and mechanic "goof" on simple cooling system precautions

• FOR LACK OF $50-60 worth of service over a five year period, owners of modern cars often incur costly major repair and shops lose customers unnecessarily, according to F. A. Gundlach, head of the Automotive Engineering Department of National Carbon Co. Discussing the current tendency—of both motorists and shop personnel—to pay little attention to the cooling system until something goes radically wrong (by which time extensive damage can take place), Gundlach said recently.

"Actually, the cost of complete cooling system maintenance for a new car should be about $10 a year—or well under that of an average motor tune-up. Over a five-year period from the time a new car is purchased, this would amount to between $50 and $60, including hose replacement, all-winter anti-freeze installation, and spring draining, flushing and rust inhibitor addition."

Pointing out that the completely enclosed and self-contained cooling system seems to instill an "out of sight, out of mind" attitude, Gundlach also noted that it has a much smaller margin of safety today from clogging or heat-insulating internal deposits. While engine sizes have increased over the last decade, he said, coolant capacity hasn't; and so today's system has the task of dissipating a great deal more heat with approximately the same coolant volume it had some 10 years ago. The understandable failures that result, often from the sustained high speed of vacation driving, usually come

without any advance warning, because no one can see what's going on inside the enclosed system.

Most common types of failures are (1) leakage, resulting in severe overheating; (2) dirty coolant, causing heat damage and lubrication failure. Both bring great inconvenience and expense.

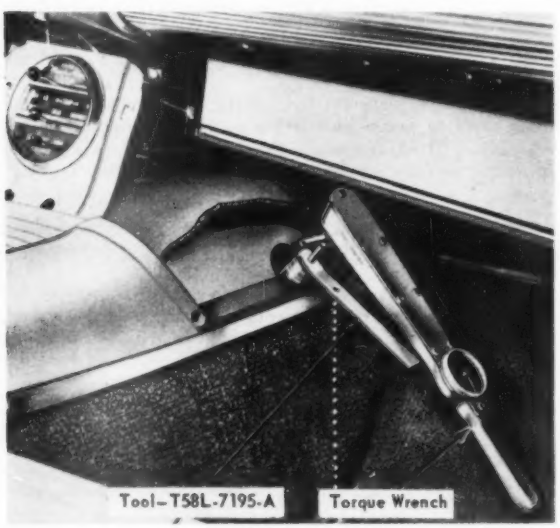
These sudden, crippling and costly failures can be avoided by correct preventive maintenance, Gundlach contends, with the full backing of AAA and the National Bureau of Standards. He advocates a four-point inspection program:

1. Looking down the filler neck into the radiator, to make sure tank and tubes are clean.
2. Visually inspecting all exterior surfaces of the system for signs of leakage.
3. Checking condition of hoses.
4. Examining the pressure cap, to see that the seal is intact and free of dirt and the rubber valve face not distorted, swollen or otherwise damaged.

The program would go a long way toward curing cooling system ills, and eliminating the common roadside sight of the car with the raised hood, he said.

Special Tool Needed to Adjust Rear Band On 1958 Thunderbird Cruise-O-Matic

The 1958 Thunderbird Cruise-O-Matic transmission requires a special rear band adjusting tool, because of restricted working space. To gain access to the adjusting



hole, the front console must be removed from under the instrument panel.

The special tool (T58L-7195-A) consists of special extension sockets, a ¾" hex for the locknut and a 5/16" square for the adjusting screw, adaptable for use with a torque wrench. Tool manufacturers have these adapters which can be used with any ft. lb. torque wrench.

Rear band adjusting procedure is as follows: Loosen locknut. Tighten the adjusting screw to 10 ft. lb., then back off the screw one and one-half (1½) turns.

WHEN CHANGING YOUR ADDRESS

Please notify us 5 weeks in advance. Supply us with both your old and new address, including address label from current issue if possible. Copies we mail to your old address will not be delivered by the Post Office unless you pay them extra postage. **Mail address changes to Circulation Dept. Automotive Service Digest, 900 South Wabash Ave., Chicago 5, Ill.**

MOST POWER PER DOLLAR!

Milwaukee

7" diameter model U-177 $87.50

9" diameter model U-199 $92.50

Heavy-Duty... Perfectly Balanced

SANDER-GRINDERS

With *Exclusive* Coaster-Brake Drive that DOUBLES GEAR LIFE

✓For Sanding . . . Grinding . . . Wire Brushing

✓Ideal Speed . . . 5000 RPM

✓Powerful *Milwaukee-Built* Motor

✓Furnished with *Milwaukee's Exclusive* Flexible Spring Steel Backing Disc Assembly

✓Full Ball and Roller Bearings throughout

See your MILWAUKEE Distributor today or write for Bulletin SG-3.

MILWAUKEE ELECTRIC TOOL CORP.

5324 W. STATE ST. MILWAUKEE 8, WIS.

AS-9430

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STEEL WORK BENCHES

BUILT FOR THE JOB!

All steel construction. Heavy duty top. Legs stay solid on the floor without bolts. Back and End Stops and Drawers available.

Sizes: 5 ft. and 6 ft. long
34" high
28" deep

Baked-on Frontier Green or Gray enamel finish

Wood Tops also available

See your Frontier dealer or write for FREE literature.

FRONTIER® MANUFACTURING COMPANY
P. O. BOX 13266 • DALLAS 20, TEXAS

De Paolo's "500" TURBO-INJECTOR

New Way to Save Gas Dollars, Engine Repairs!

for: All Ford Products

$12.95 LIST

- **Quickly, Easily Installed**
- **Built and backed by a great automotive name — Peter DePaolo**
- **Efficient, economical operation for the life of your car!**

This revolutionary new unit injects conditioner or top cylinder oil directly into the critical upper cylinder heat zone — converting the oil into a mist which combines with the air-fuel mixture to provide constant lubrication and conditioning as the engine requires it.

These are the benefits of the "500" Turbo-Injector: Improved Gas Mileage (up to 50%!); Greater Engine Performance; Quieter Operation; (Cushioned Valve Action!); Longer Spark Plug Life; Lower Engine Maintenance Costs! The De Paolo "500" Turbo-Injector is a championship performance product — engineered and sold by a Champion!

World-Wide Life GUARANTEE

Send name & address of your jobber TODAY!

De Paolo's "TOP 500" ENGINE CONDITIONER OIL

The upper-cylinder lubricant that promotes top power, performance, mileage! Most effective with Turbo-Injector. Can also be added thru gas tank or carburetor. $1.25 LIST, 12 oz. size.

De Paolo Engineering Co.
2630 E. Spring St., Long Beach 6, Calif.

The Powermatic . . . *(Continued from page 49)*

Throttle Linkage: This adjustment must be made accurately and in the proper sequence. Begin by disconnecting the throttle control rod from the bracket assembly. Move the linkage manually to full-throttle position, then insert a ¼" dowel pin (or drill) through the three holes in the shaft and bracket assembly.

Adjust carburetor link so that the carburetor is against full-throttle stop.

Pull throttle rod upward until motion is halted by the transmission throttle lever hitting its internal stop. In this position, adjust the throttle clevis so that it just fits onto the pin previously installed in the shaft and bracket assembly. Then lengthen the rod by running out the clevis ten (10) full turns on 272 and 292 cu.in. engines, or nine (9) full turns for 302 and 332 cu.in. engines. Then connect the control rod to the bracket assembly.

Remove the ¼" locking pin, and place the carburetor linkage in its hot idle position. Using a 0.020" feeler gauge, check the clearance between the bellcrank and the stop screw. If adjustment is necessary to establish the 0.020" clearance, adjust the position of the stop screw in the elongated slot as required.

Accelerator Pedal Height: This dimension varies considerably according to vehicle make and model. It can be as little as 2½", or as much as 5⅛". Regardless of amount of clearance, the adjusting principle is the same.

To establish recommended pedal height, vary the length of the pedal connecting link. Also adjust pedal stop bolt so that there is a clearance of three threads between pedal and bolt when the throttle linkage hits its stop past the detent.

Complete adjustment by making sure the accelerator cross shaft to pedal link is parallel to the centerline of the engine. If adjustment is necessary, loosen locknut on adjusting screw and align as required. Securely tighten locknut.

Retarder Pedal Linkage: Adjust pedal free height to 4½", and height of pedal stop to 2⅛". Again, these dimensions can vary.

Disconnect retarder control cable at the transmission. Pull the retarder lever rearward until the retarder valve bottoms in its body. This can be both heard and felt.

Pull retarder cable toward transmission until pedal contacts stop bolt. In this position—valve bottomed and pedal on stop—adjust cable sleeve until sleeve pin freely enters hole in the lever. Then attach the cable to the lever. Check adjustment by pushing the pedal against its stop and listening to hear if the retarder valve bottoms. If it does, adjustment is O.K.

FLUID TEMPERATURE LIGHT

When servicing the retarder, it is especially important to check the operation of the retarder fluid temperature warning light. The light should go *ON* when the key is turned to Start, and *OFF* when the key is returned to On. This light serves as a warning to the driver to stop using the retarder until the oil cools down.

The Powermatic-type automatic transmission is an expertly engineered piece of equipment which is capable of long life, even in heavy-duty vehicles. Because of its many advantages, it's very likely that more and more trucks will offer it as an optional item. Eventually it may do for the truck field what other automatics have done for passenger cars.

Next month: Servicing the Twin-Hydramatic.

Say You Saw It In Automotive Service Digest

Home Training Program in
AUTO MECHANICS

A comprehensive program which serves excellent for review or reference. Ideal for the man who has picked up a little here and there and wants to systematize his knowledge. Employers interested in sponsoring the program for selected employees can take advantage of tuition discount plan. Write for free information.

ALLIED INSTITUTE OF TECHNOLOGY
1338-42 So. Michigan Ave., Dept. ASD-68, Chicago, Ill.

leaves no odor—
cleans faster.

"I LIKE 606 BECAUSE . . .

it has all the high qualities a carburetor cleaner should have, economical, fast, easy on the hands, very little odor and a perfect water rinse."

Signed testimonial from service men at Bayer City Service, 49th and College, Indianapolis, Ind.

GRAYMILLS CORPORATION
3736 N. Lincoln Ave., Chicago 13, Ill.

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HE WHO LAUGHS, COME WHAT MAY,

WILL LIVE TO LAUGH ANOTHER DAY

Short circuit smiles

If he sold a certain suit, the young high school graduate was told, he could have the job as clothing salesman. The suit in question was a dilly—light purple, with yellow stripes, and red dots.

An hour later, bloody, dirty, clothing torn, he rushed up to the manager and shouted breathlessly, "I sold it."

"Looks as if you met a lot of customer resistance," said the manager, looking him over.

"No, I had no trouble with the customer," the youth replied, "but what a fight I had with his seeing-eye dog."

★ ★ ★

• Ever notice that it's always the girl with the best looking legs who sees the mouse first.

★ ★ ★

For sheer shrewdness, few outrank the waiter or waitress out to make the day's quota of tips—as consider this one, working in a New York coffee shop. A man walked into the shop during a busy lunch hour rush, ordered a cup of coffee, gulped it down, left 10 cents on the counter and walked out. Quickly, the waitress scooped up the coin, put it in her pocket and turned to the next customer — only to catch the cold eye of the owner staring at her.

She hesitated a moment, then shook her head sadly. "What a screwball!" she confided. "Leaves a 10 cent tip—then walks out without paying."

★ ★ ★

A widow, ordering a tombstone to be erected in memory of her late husband, insisted that it contain this inscription:

REST IN PEACE—TILL I COME

★ ★ ★

Uncle Jeff (from Tennessee) came to town for the first time in over fifteen years. While rubbernecking down one of the back streets he saw a sign on a plumbing shop window, "Cast Iron Sinks." He looked at it, then mumbled to himself —"Well, any dang fool knows that!"

An enterprising real estate salesman of the western part of Texas finished describing the area to a prospect from the East by concluding: "All west Texas needs to become a garden spot is a little more water and some good people to settle on it."

"Yeah," replied the easterner, "that's all Hell needs, too."

★ ★ ★

Getting married is a good deal like going into a restaurant with friends. You order what you want, and then you see what the other fellow has got, you wish you had taken that.

★ ★ ★

Sign on a chicken house: "Warning: Anyone found prowling around here at night will be found here in the morning."

★ ★ ★

Wife to sick husband: "What do you mean you have nothing to live for? The house isn't paid for, the car isn't paid for, the TV isn't paid for. . . ."

"Aren't you letting your raise go to your head a bit, Carswell?"

A butcher who had had a particularly good day proudly flipped his last chicken on a scale and weighed it. "This one will be $1.35," he told the waiting customer.

"That really is a little too small," said the woman. "Don't you have anything larger?"

Thinking fast, the butcher returned the hen to the refrigerator, paused a while, then took it out again. "This one," he said proudly, "will be $1.65."

The woman paused for a moment, then made her decision. "I know what," she said, "I'll take them both."

★ ★ ★

• The guy who said there was no use crying over spilled milk probably only paid eight cents a quart.

★ ★ ★

A sheltered young New Yorker out on his first trip to the West was especially impressed with the sheer skill with which one cowboy rolled his cigarettes.

"Aw shucks," said the latter, "'tain't nothing to rolling them. It's adding the filter that gets me."

★ ★ ★

A Los Angeles maternity shop recently received this letter from an indignant customer: "Dear Sirs:

Please cancel the order for a maternity dress which you were going to deliver to me. My delivery was faster than yours."

★ ★ ★

It was a rough crossing on the English Channel and the spray flew over the decks. The captain called down, "Is there a mackintosh down there big enough to keep two young ladies warm?"

"No," shot back a voice, "but there's a MacPherson willing to try."

★ ★ ★

A very fussy office manager was giving instructions to a young salesman regarding his trip. He gave him explicit detailed orders charting out minute by minute the young man's every action.

"You'll leave on the train at 7:00 a.m. and you'll reach your destination about 9:00 a.m. It's all right to have a cup of coffee at the station but make sure you're in a cab by 9:10 a.m. That will get you to Blank & Blank's by 9:30 a.m. I want to hear from you if there are any slip-ups. Remember—wire me if there is any difficulty of any kind at all, understand!"

About 9:30 the next morning he received this telegram: NO CREAM AT THE STATION—WHAT SHALL I DO?

★ ★ ★

"Well, Doc," asked the aging patient after being examined, "How do I stand?"

"I don't know, frankly," replied the doctor. "To me it's a miracle."

★ ★ ★

Sign seen outside an Indianapolis gasoline station: "Notice to our Patrons! Because of the number of complaints about our free service, the management has decided that effective today, there will be no free service."

CHROME C-9 OIL RINGS WITH CIRCUMFERENTIAL EXPANSION ACTION
. . . for newer engines

Newest advancement in ring design assures a new high in conformability. With an average of 60 outward thrusts, C-9 adapts easily to cylinder variations and variable operating conditions.

CHROME SPIRO-SEAL OIL RINGS WITH CIRCUMFERENTIAL EXPANSION ACTION . . . for older engines

A new high in conformability. Works like a watch spring; gentle outward pressure lets Spiro-Seal adjust to any taper or wear. Provides equalized radial pressure against cylinder wall for positive oil seal.

SMART MOTORISTS WANT RAMCO RE-POWERING

for longer engine life . . .

Of course, they don't *know* they want RAMCO rings—they just want that ring job to *last!*

And so do you, if you want satisfied customers. That's why smart engine men call for RAMCO 10-Up Sets—the kind that last and last and last and last—and bring in "recommend" customers.

Smart engine men know each 10-Up Set contains either Chrome C-9 or Chrome Spiro-Seal oil rings—each with *circumferential expansion action*—each "power-engineered" with chrome to make *any* age engine feel young and gay. That's why you're DOUBLE SURE you'll re-power right—RAMCO right—when your work sheet calls for RAMCO 10-Up Sets.

Be DOUBLE SURE! Call your RAMCO Jobber today.

DOUBLE SURE RAMCO 10 up SETS

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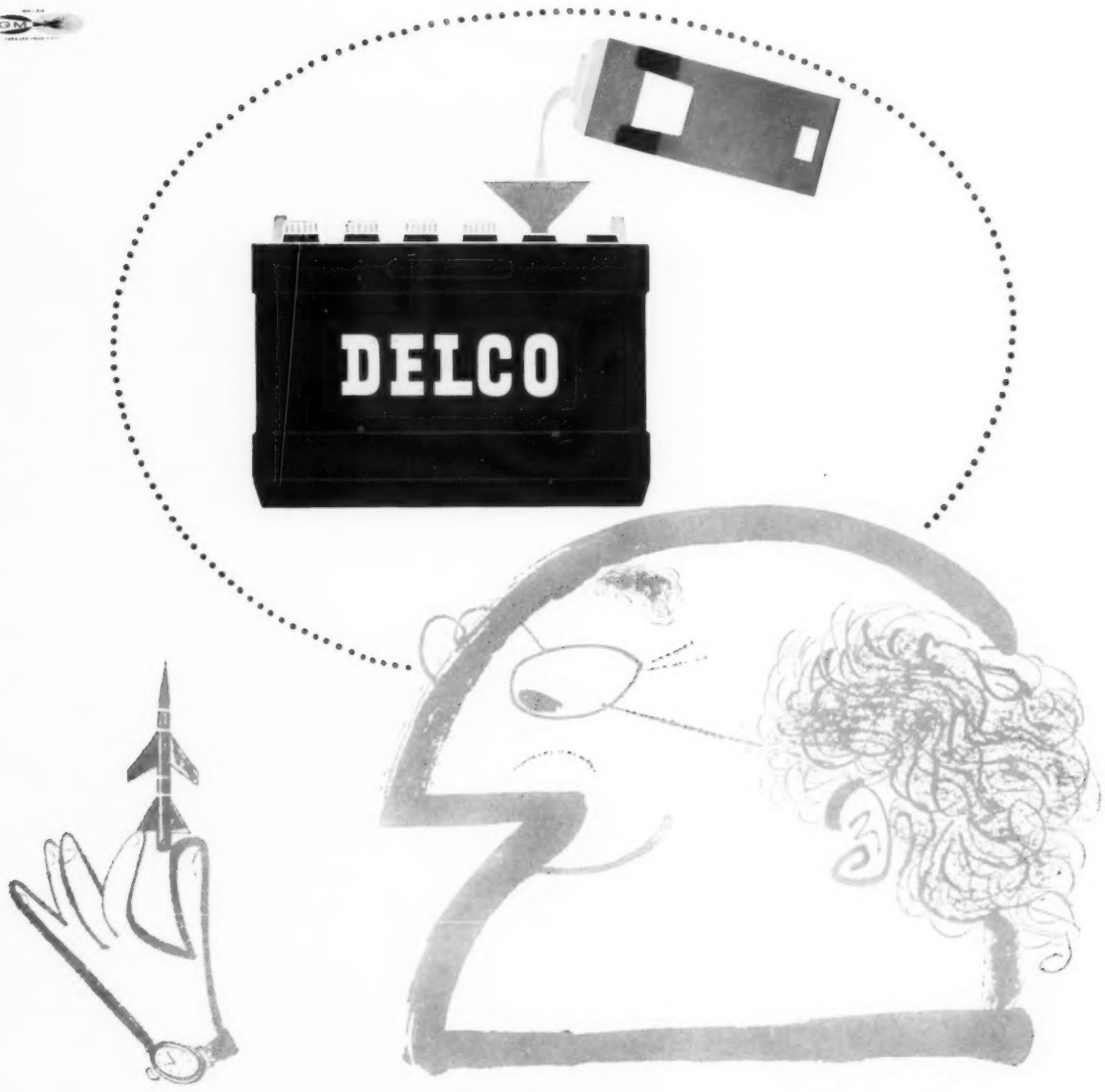

GUIDED MISSILE EXPERTS

want Delco DC batteries. That's why they're easier to sell.

Three separate surveys were made by three different national magazines. All proved that Delco is America's No. 1 battery preference. But why not? Delco Dry Charge batteries *stay* factory-fresh, they're priced right, and backed by General Motors warranties that are good all over the United States and Canada. More than that—Delco is supported by the strongest advertising in the industry: on TV, "High Adventure with Lowell Thomas"; on radio, Lowell Thomas Newscast; plus full-page ads in Life, Look, Post, and Reader's Digest. Maybe none of your customers are guided missile men, but battery sales will rocket anyhow if you stock Delco. You see, it's easier to *sell* Delco DC, because more people *know* Delco DC.

Quality built by Delco-Remy
distributed nationally through

GM U-M-S PARTS SALES
UNITED MOTORS SYSTEM

General Motors leads the way—Starting with Delco Batteries